JOURNAL

OF THE

FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

AND

MECHANICS' REGISTER.

DEVOTED TO

Mechanical and Physical Science,

CIVIL ENGINEERING, THE ARTS AND MANUFACTURES,

AND THE RECORDING OF

AMERICAN AND OTHER PATENTED INVENTIONS.

JANUARY, 1837.

Practical and Theoretical Mechanics and Chemistry.

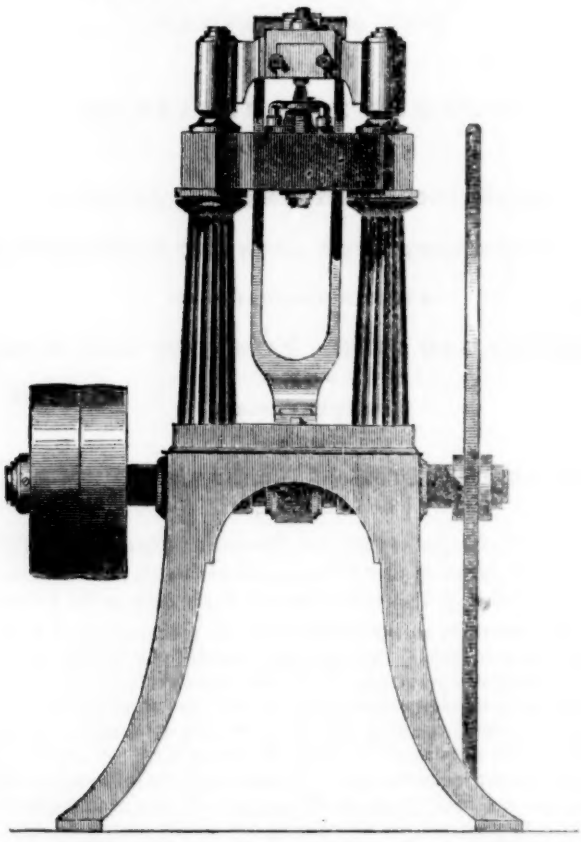
Description of Presses for cutting out Blanks, or Planchets, for Coin, made for the Branch Mints at Charlotte and Dahlonega, from designs by, and under the direction of, FRANKLIN PEALE, *of the Mint of the United States.*

It is always desirable in the construction of machines, that there should be no redundancy of parts, and that they be made as simple as is consistent with efficiency of operation. It is also equally desirable to distribute the requisite parts in as symmetrical a form as the object of their construction will permit, not forgetting that the laws of good taste are as applicable to machinery as to architecture, or to any other form in which inorganic matter may be presented to the eye. It was under the influence of these sentiments that the machine which is the subject of this notice was designed.

The preparatory operations of coining are briefly stated for the information of the general reader. The ingots of standard metal, after being rolled to the desired thickness, nearly, are taken to the *draw-bench*, and by its operation are equalized in thickness throughout. They then pass to the *cutting-out press*, a few pieces are cut from the end of each *slip*, (the rolled and drawn ingot thus called,) and weighed, to test their accuracy, and if satisfactory in this respect, the whole *slip* is passed under the operation of the cutting-out press, the operator being assured that the several pieces cut out of the slip are of the same weight, or so nearly approximated to it, as to be within the *allowance* for error of workmanship provided by the Mint law.

A square table of cast-iron supports a shaft, upon one end of which is the usually formed fast and loose pullies to receive motion from the propelling power by a band. On the opposite end is a fly wheel, also of cast-iron. In the centre of this shaft, between the two journals on which it turns, is an eccentric, formed within the diameter of the shaft, and connected with the *bridle* (to be noticed hereafter,) by a *stub-end* and *strap*, constructed in the usual manner.

Front view of the Cutting-out Press.



The table supports also two columns, upon which rests a kind of architrave, forming a seat for the die, to which the latter is secured by two hooks with screws and nuts. Above each column is a circular guide rod, for the *cross head*, which is made of bell metal. In the centre of the cross head is the bed for the punch, with a *follower* closing upon it, and secured by two screws. Over the *cross head* passes the *bridle*, which is constructed of iron in one piece, and is secured to the cross head by a cap. By means of this *bridle* the motion of the eccentric, (which does not exceed three-eighths of an inch,) is communicated to the cross head and punch; the latter descending into the bed a short distance, when the eccentric is at its lowest point

To the bed of the die is attached a *stripper*, *guide*, and *stop*. The first serves to draw the strip off the punch, when the latter rises; the second to guide the strip laterally; and the last to determine the distance to which the strip is pushed forward, so as to ensure regularity, and of course economy, in cutting out the greatest number of pieces that the strip is capable of yielding.

Cutting out presses on this principle are rapid and efficient in their operation; they will cut out 160 pieces, or more, per minute, and are not subject to derangement; and finally require very little power to move them, the momentum of the fly being sufficient to pierce the slip when running at the rate mentioned above.

These cutting-out presses were made by Messrs. Merrick and Agnew of this city, and we have great pleasure in stating that in exactness of execution, beauty of finish, and general style of workmanship, they are satisfactory in the highest degree. In these respects they are not surpassed by any machines of foreign or domestic execution. The presses, milling machines, and some other of the apparatus for the Branch Mints, have been executed by the above firm, to all of which these remarks are equally applicable.

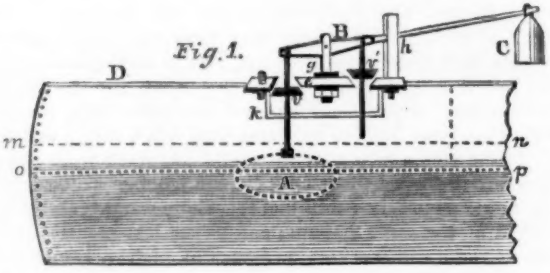
It is proper here to mention, that when the first press was constructed, Mr. Rufus Tyler was a member of the firm, and had the superintendence of this part of the work.

Mr. Samuel Raub's Safety Apparatus for Steam Boilers.

(Communicated for this Journal by Prof. W. R. Johnson.)

This igenious, but simple and efficient plan for indicating the deficiency of water in a steam boiler, is presented in the accompanying sketch, (fig. 1.)

Fig. 1.



D is a vertical section through the length of a cylindrical steam boiler, without an interior flue; *m n* is the ordinary water line, and *o p* is the fire line of the same boiler. On the top of the cylinder is riveted a plate of brass *e*, serving for valve seats, and through the centre of this plate passes the upright iron pillar *g*, with a fork at top to receive and support, on an axis, the lever B. On opposite sides of the axis, and at equal distances from it, are attached to the lever the rods of the two equal valves *v* and *v'* the former of which opens inwards, and the latter outwards, so that any pressure of steam within the boiler which tends to open the one, tends by an equal force to close the other; but any force which is applied to either arm of the lever, tends to affect both valves in the same manner. *h* is a simple guide rod, in the slit of which the lever plays, and *k* a guide for the valve rods on the inside of the boiler. A is a solid, or hollow, metallic body,

having, from its form when hollow, a specific gravity rather greater than that of water, and is kept, generally, quite immersed in the liquid, but when from any cause left uncovered by the water, it tends to descend by a force which is measured by the weight of such a bulk of water as there may be of the solid laid bare. Thus if there be one cubic foot of the solid above the level of the water, the force it will exert to open the valves will be about sixty-two pounds. This equality between the bulk of the body uncovered and the weight of water which measures its gravitating power, is the consequence of being counterpoised by the weight C, which, under ordinary circumstances, is just sufficient to keep the valves at their seats, when A is completely immersed. It is evident that as the valves are similar, and of opposite tendencies when urged by the steam, and as they are attached at equal distances, on opposite sides of the fulcrum of the lever B, they are, under all circumstances of pressure in the boiler, equally prone to obey any external force, and as the relation between the specific gravity of water and that of an immersed incompressible solid is not changed by the circumstance of both being under a pressure of steam, no impediment is felt to the action of the valves when the steam is up, more than when the boiler is filled with cold water and common air.

It is true, the relation of the specific gravity of the solid, and of the steam in which it is immersed when not covered with water, is changed with the pressure of steam; because, unless surcharged with heat, the latter has its *density* increased in proportion to the pressure, but the relation between the density of water at all known temperatures, and of steam at any working pressure, is such as to preclude the supposition that the buoyant power of the latter can ever become sufficiently important to modify the action of the immersed body. Thus, since water is 815 times heavier than common air, the latter will buoy up a body immersed in it, 1-815th part as much as the former fluid. Hence, any solid immersed, and floating indifferently in water in vacuo, at 60° and then raised above its surface, would there weigh one eight hundredth part more than if raised into a medium of the density of common air; but if raised into a medium having the density of *common steam*, that is, vapour which counterpoises the pressure of the atmosphere, it would weigh only one 1696th part less than when raised out of water into a vacuum. If the steam into which it might be raised were at a pressure of two atmospheres, the weight lost by a change from a vacuum to steam of that tension, would be nearly 1-848th of the whole weight; and if of ten atmospheres, 1-169th of the same amount; and as the last mentioned pressure is probably above the mean working pressure of high pressure boilers, it is evident that the greatest difference between the effect of the immersed body when tried in atmospheric air, and in high pressure steam respectively, would be only about one half of 1-170, or one 340th of the weight of water which is equal to its bulk. This in the case of a float having a bulk of one cubic foot, would be less than one-fifth of a pound. Hence, if an apparatus of this kind be properly adjusted at common temperature, and while the steam chamber is yet filled with atmospheric air, it would not be sensibly diminished in efficacy by a pressure of steam of twenty atmospheres, or twice as great as the highest working pressures now deemed useful in the steam engine. With regard to the form of the immersed body, the inventor has not restricted himself, but practice will doubtless indicate the propriety of making its vertical dimension small, so that when the water once comes down to its upper surface, its whole bulk may become as speedily as possible uncovered, and effective towards opening the valves. This condition

must, however, be made consistent with the free escape of steam, generated below the immersed body, to the steam chamber above; hence a division of the body into several distinct portions, united by inflexible bars, may sometimes be found expedient.

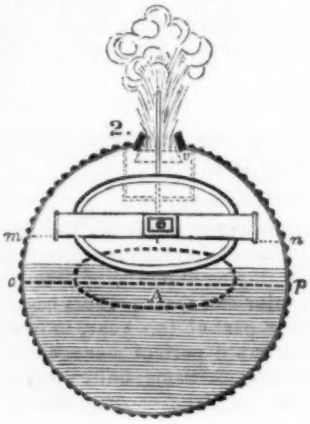
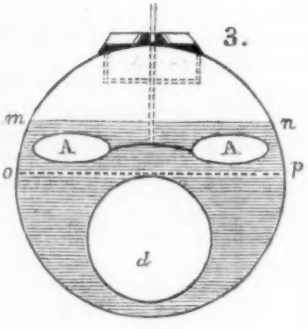
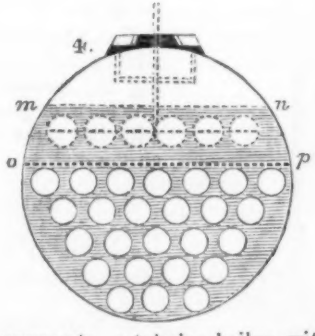


Fig. 2. represents the form and action of the apparatus in a common cylindrical boiler. The depth of the body A is about the same as the distance between the lowest safe water line and the highest fire line outside of the boiler; it might be as much less than this, as it should be found convenient to make it, and its upper surface should, when suspended in the water, be coincident with that of the water at the moment it has come down to the level just indicated. In this figure the apparatus is represented as in action, the same as in fig. 1.



In fig. 3 is seen a vertical section of the apparatus, such as may be used in cylindrical boilers, with interior flues. Two distinct portions of the immersed body, A A, are united by an inflexible rod, curved upwards to conform, when required, to the exterior of the flue *d*. This arrangement facilitates the escape of steam generated by the top part of the flue. The marks for water lines and fire lines are the same as in figs. 1 and 2.



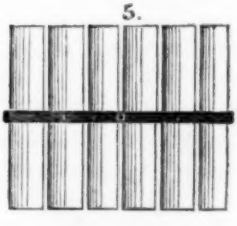


Fig. 4 represents a tubular boiler, with the immersed body formed of a series of pieces of tube, closed at both ends, and connected together by

rods into a kind of grate-formed assemblage as more distinctly seen in fig. 5. The tubes used in this apparatus may be of the same diameter as those constituting the boiler, or of any less size, affording ample freedom for the escape of steam through their interstices, in its passage from the boiler tubes below, to the steam chamber above.

In figs. 2, 3 and 4 the interior valve only is exhibited; the rest of the apparatus being entirely the same, whatever is the form of the immersed body, or of the boiler in which it is used.

Description of an Apparatus for conveying orders to Steamboat Engineers.

By A. C. Jones, *Engineer.*

TO THE COMMITTEE ON PUBLICATIONS.

Gentlemen—Being impressed with the imperfection of the method now in use on board of steamboats, for conveying information to the engineers, i. e. by the use of two bells of different tone, the ringing of one being frequently mistaken for that of the other, from which injurious consequences have frequently arisen, I took the liberty, in the early part of this year, to forward to the Secretary of the Navy, a plan for the more perfect management of the engines on board of the steam batteries, about being built by government; this, or some similar scheme, I think would be of decided advantage on board of all steamboats.

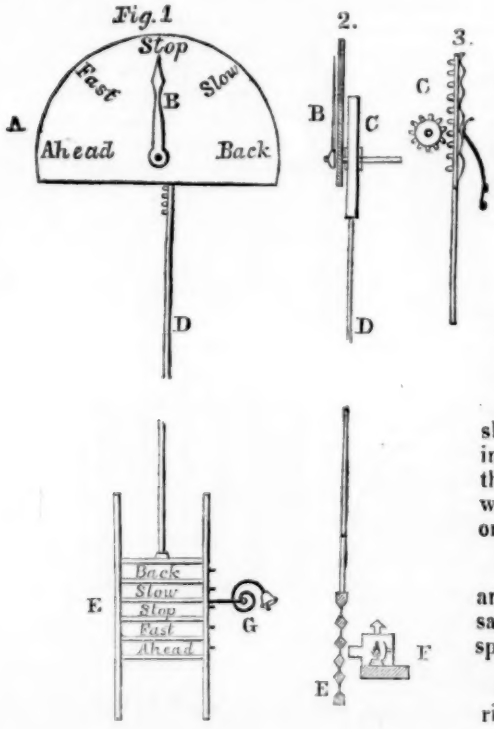


Fig. 1 is a front view.

Fig. 2 a cross section of fig. 1.

Fig. 3 shows the rack and pinion, with the spring to prevent it changing its position, except when necessary.

A. Dial.

B. Index.

C. Pinion working in the rack attached to the rod D.

E. The movable frame sliding in the guides, having five spaces with mica, thin horn, or glass, in each, with the same mottos as on the dial A.

F. The lantern; this has an opening in front, of the same size as one of the spaces divided in E.

G. Pins to set the bell ringing.

In submitting this device to your notice, I have made a little deviation in the figures from those forwarded to the Secretary of the Navy. Some modifications of the arrangement will be necessary, on board of each boat, according to circumstances.

The references and figures below will show the plan I have suggested. Suppose the vessel to be running ahead, and the commander wishes her to go in the contrary direction, he moves the index on A to the word "BACK," this changes the place of the frame E, and the engineer sees the direction to back by the motto, which is illuminated by the light of the lantern passing immediately through it; and so with any other direction that may be necessary, by simply moving the index. To make this plan as perfect as possible, there may be projections on the sliding frame which, when it is moved, causes the ringing of a bell to attract the notice of the engineer.

Respectfully yours,

A. C. JONES.

Progress of Physical Science.

Communication of Observations of the Solar Eclipse of May 15, 1836, *and of an Aurora, on the evening of May* 10*th.* By AMASA HOLCOMB, *of Southwick, Mass.*

TO THE COMMITTEE ON PUBLICATIONS.

GENTLEMEN:—The solar eclipse of May 15th, began at 7h. 17m. 52.22, mean time, and ended at 9h. 49m. 20.05, mean time, as observed at my residence, Southwick, Mass., latitude north 41° 59′; *longitude West 4h. 51m. 10s. The observation was very satisfactory.

On Sunday evening, May 10th, 1836, there was, at Southwick, a very splendid aurora. At half-past nine o'clock a stream of light rose in the east, passing through α Herculis to α Coronæ, and gradually extending to ε Bootis, through Ursa Major and Pollux. At forty-three minutes past nine it passed over Jupiter three degrees south, which was about twenty degrees above the western horizon. At fifty minutes past nine the whole arch had passed about six degrees south of Arcturus, and between Regulus and γ Leonis. At five minutes past ten it wholly disappeared.

It was very light in the north during the whole time of the visible aurora, and afterwards to a late hour. The arch was irregular in its width, being in some places not more than two degrees, in others four degrees. The waves passed from east to west, but not exactly in the direction of the arch. They appeared to begin on the north side, to run obliquely and pass off at the south side.

AMASA HOLCOMB.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Report on Hourly Observations of the Thermometer at Frankford Arsenal, Pennsylvania, by Captain Alfred Mordecai, of the United States Ordinance Department.

The observations which form the subject of this communication, were made at the suggestion of a friend, (Professor A. D. Bache,) who is a mem-

* Deduced by S. C. Walker from this observation.

ber of the Joint Committee on Meteorology of the American Philosophical Society, and the Franklin Institute, for the purpose of obtaining data for determining the laws of diurnal variations of temperature.

The observations were made during the day time, chiefly by Mr. William Pigott, the clerk in the office of the Arsenal, and at night by the guard: and I have reason to think that their correctness may be generally relied on, so far as the thermometer made use of will authorize. The instrument is one of Fishers', of Philadelphia, which was found to agree very well with a good French thermometer, with which I compared it for some days. As it would not have been convenient to use a screen which could have admitted of the thermometer being kept stationary at all times of the day and night, its place was changed in the morning and afternoon, so as to keep it protected from the direct rays of the sun, as well as from reflection; in the day time it was screened by a green venitian window blind, the window being kept always closed. There is no doubt that the influence of this change of place, and of the proximity of buildings, was felt by the thermometer, but from careful observation I do not find that the general results were materially affected by these causes, the effects of which having, moreover, extended over the whole period of time, would have little influence on the comparative results. I have, however, to regret that, being without any other aid than that of my private funds, I was not enabled, for want of the most suitable instruments, to conduct these observations in so satisfactory a manner as I might have done. I give them as the first attempt of the kind, so far as I know, on this side of the Atlantic, in hopes that they may be of some use for the purpose of comparison with such observations as have been made in Europe, and that they may perhaps afford a first guide for more full and correct observations at home.

Whilst I was engaged in drawing up this report, I received the Fifth Report of the meeting (in Dublin) of the British Association for the Advancement of Science, which contains the able paper of Mr. Snow Harris on this subject, and it will be perceived that I have availed myself of the knowledge thus obtained with respect to the most judicious method of presenting the results of my observations, although the observations do not extend over so much time as to entitle these results to the confidence that may be placed in those of Mr. Harris.

Frankford Arsenal, the place at which these observations were made, is about five miles in a north-easterly direction from the State House in Philadelphia, latitude 40° N., longitude 75° 8′ W. from Greenwich. The Arsenal is about a quarter of a mile from the west bank of the Delaware river, in an open, level country: the usual position of the thermometer is about twenty-four feet above ordinary low water in the Delaware.

My register was commenced on the 7th of May, 1835, and continued until the 31st of May, 1836, since which time it has not been convenient for me to have it carried on in such detail. I continued it through the month of May, 1836, because the register of that month in 1835, was not quite complete, and because I was apprehensive that the want of habit on the part of the observers, would make the observations of the first month less entitled to confidence than the others. In making up the mean results, it has been necessary, however, to use the observations of the month of May, 1835, as that is one of the six summer months of the period through which the observations extended; the results for the month of May, 1836, are therefore recorded only for preservation and comparison, and are not used in making up the mean results that we shall have under consideration,

except in taking the mean of the three spring months to which it belongs. The results of the observations in question oblige me, in making up the average of the several seasons, to consider May, June, July, August, September, and October, as the six summer months, being very distinctly those which give the highest range of the thermometer, as well as corresponding rates of variation. March, April, and May, are taken as the spring months: June, July, and August, as the summer months: September, October, and November, autumn months: December, January, and February, winter months: Tables I. and II. contain the numerical results of the observations, arranged in a manner which will be readily comprehended on inspection. Table I. shows the mean temperature of each day in the thirteen months, and also the mean of the highest and lowest temperature observed on each day, together with the general result for each month.

Table II. shows for each of the several periods of time, mentioned in the first column:

1. The mean temperature of each hour.
2. The general mean of the hourly observations, and of the diurnal extremes.
3. The days on which the highest and lowest temperatures were observed, and the amount of the maximum and minimum.
4. The difference of the maximum and minimum, or the extreme range of temperature.
5. The hours at which the mean maximum and minimum are respectively found.
6. The hours, before and after noon, at which the thermometer indicates the mean temperature of the day.
7. The relation between the mean temperature of each hour and that of the whole year.

In drawing general inferences from the results contained in these tables, it must be recollected that the observations extend over only *one* period of twelve months, and also, that the particular seasons embraced in that period were not such as we have usually had of late years; the summer was more temperate, and the winter colder, with more snow than usual.

The following results, deduced from the tables, are here stated, with a view of bringing them more distinctly under observation, viz.

Mean temperature of

10 days about the summer solstice, viz:—from June 16th to 25th, inclusive, - - -	65.19
10 days about the winter solstice, viz:—from December 16th to 25th, inclusive, - - -	27.48
Summer, viz. June, July, August, - -	69.40
Autumn, viz. September, October, November, -	53.54
Winter, viz. December, January, February, -	26.88
Spring, viz: March, April, May, (1836,) - -	48.02
6 summer months, viz. May to October, inclusive, -	63.77
6 winter months, viz. November to April, inclusive, -	34.64
12 months, viz. May to April, inclusive, - -	49.21
April being nearest to that of the 12 months, -	48.65
Maximum temperature observed July 13th, at 3 and 4 P. M.	89.5
Minimum temperature observed February 6th, at 5 and 6 A. M.	—7.
Extreme range of temperature,	96.5
Mean range between six summer and six winter months,	29.13

Table I. gives some idea of the fluctuations in the temperature of our climate, occurring within a short space of time: thus it will be seen that

there is in some parts of almost every month, a variation as great as 12° in the mean temperature of two consecutive days; and that, in the winter and spring, this variation often extends to 15° or 18°. In Mr. Harris' register of observations during two years at Plymouth, England, there is only *one* instance of a difference exceeding 8° in the mean temperature of two consecutive days, and but two other instances of a difference as great as 8°. The extreme range of temperature at Plymouth, in 1834, was 48°, just one half of the range at Frankford Arsenal in 1835–6.

In order to illustrate more clearly this peculiarity of our climate, I subjoin a table showing the extreme variation or range of the thermometer during the three days of each month on which the difference of extremes is greatest.

Table III. showing the extreme range of Temperature during three days of each month.

1835	Date	Interval of time between the extremes.	Difference of extremes.	1836	Date	Interval of time between the extremes.	Difference of extremes.
		Hours.				Hours.	
May	11th	10½	34.	January	2nd	12½	25.5
	17th	9½	31.		21st	12	27.5
	24th	10	29.		29th	10	26.5
June	2nd	11	28.	February	6th	8	28.5
	9th	12	31.		15th	9	23.5
	23rd	13	29.		19th	15	26.
July	2nd	11	26.5	March	3rd	11½	29.5
	11th	10	26.5		13th	11	26.5
	26th	12	26.		24th	10	26.5
August	3rd	11	25.	April	8th	8	28.
	8th	11	25.		26th	11	32.75
	24th	12	26.5		28th	10	27.
Sept.	3rd	11	28.5	May	2nd	13	33.5
	16th	10	29.		11th	11	30.
	27th	11	27.		16th	11	32.
October	4th	11	30.				
	14th	9	28.5				
	26th	8	27.				
Nov.	2nd	13	21.				
	14th	8	24.				
	30th	13	23.5				
Dec.	4th	12	22.5				
	9th	12	28.				
	24th	10	21.				

With the assistance of Table I. it will be easy to ascertain, if desirable, the degrees of extreme temperature on the days mentioned in table III., by taking from the former table the mean of extremes for the given day, and adding to it half their difference, from Table III., for the maximum, or subtracting the same half difference for the minimum.

Daily Progression of Temperature.

In order the more clearly to exhibit the changes of temperature during

the twenty-four hours, I have projected, in the form of curves, the temperature of each hour for each of the four seasons, and also for the two extreme months, July and February, and similar results for the six summer and the six winter months; also for the twelve months, and for the month of April, which approaches the nearest to the general mean. *See plate I., fig. 1 and 2.* From an examination of these registers, it appears that the minimum point is attained during the hour preceding the rising of the sun. This is observable with great regularity in the summer season; in the winter, when we might expect the thermometer to be more affected by accidental circumstances, the lowest point is often found about midnight; but taking the result of many days together, the same rule applies to both seasons. Thus the mean time of minimum temperature is, for the *six* summer months, *at* 4 *A. M.*, for the *five* winter months at 6 *A. M.* For the twelve months, the lowest point is found at 4 A. M., but the difference between the mean temperature of that hour and of 5 A. M., which from analogy should give the lowest mean, is so small, being less than one-third of a degree, that further observations might establish the minimum *at* 5 *A. M.*, where we should expect to find it.

From the lowest point the temperature increases rapidly until 1 P. M., when it has nearly attained its maximum, rising little more than half a degree during the next hour. The maximum point is found sometimes at 2, and sometimes at 3, P. M., and the temperature at those two hours is so nearly the same, not only for the whole year, but for any period of three or six months, as to warrant our assuming $2\frac{1}{2}$ *P. M. for the true maximum point.* At 4 P. M. the temperature is nearly the same as at 1 P. M., it then falls steadily until about an hour before attaining the minimum, after which, as at 1 P. M. in ascending, the change is very small.

In discussing the results with relation to the mean variation of temperature, we may assume 4 A. M. as the hour of minimum for the six summer months; 5 A. M. for the six winter months; and $4\frac{1}{2}$ A. M. for the twelve months; $2\frac{1}{2}$ P. M. being always the hour of maximum. The following tabular statement presents at one view, the principal results of this discussion.

	Six summer months.	Six winter months.	Twelve months.
Mean daily range of temperature,	17.23	11.81	14.36
Time of ascending temperature,	10h.	9½h.	10h.
Time of descending temperature,	13½h.	14½h.	14h.
Mean hourly rate of ascending temperature,	1.64	1.24	1.44
Mean hourly rate of descending temperature	1.28	0.81	1.03
Ratio of mean rates of ascending and descending,	5 to 4	3 to 2	7 to 5
Greatest hourly variation in ascending,	(From 7 to 8) 3.10	(From 9 to 10) 2.13	(From 7 to 8) 2.53
Greatest hourly variation in descending,	(From 6 to 7) 3.05	(From 5 to 6) 2.17	(From 6 to 7) 2.50

I have not thought it advisable to increase the number of plates, or to encumber the annexed diagrams, by projecting the curves for each month separately, but I have done this for my own satisfaction, and it is gratify-

ing to observe the agreement, in general character, between each of these curves and the mean curve for the summer and winter period to which it belongs. This agreement is, without exception, in the six months from May to October inclusive; and in the other six months the only deviation, (and that not a remarkable one,) is in the month of April, the curve of which corresponds, as before observed, with that for the mean of the twelve months. November is the month whose mean temperature approaches nearest to that of April, but the flattened form of the curve, indicating a restricted range of temperature, marks it as belonging to the winter set, although the mean minimum of November exceeds the mean maximum of March, the nearest winter month.

The gradual diminution of temperature, uniformly observable on the approach to the minimum, shows that there is not, as some have imagined, any sudden increase of cold about the time of dawn; the opinion has doubtless originated in the feeling caused by the action of the greatest cold of the night, (which is found to be at the time referred to,) on the body previously chilled by exposure.

On the Hours of Daily Mean Temperature.

This may be regarded as the most interesting and useful part of the discussion of such observations as we are now considering, since the determination of the hours, before and after noon, at which the thermometer indicates the mean temperature of the day, will enable us to ascertain the mean temperature at any place, by two observations during the day, or even by one.

The hours of mean temperature are given in Table II., for each of the several periods of time embraced in the table, and need not be here repeated; it will be seen that with one exception, that of the morning mean for November, the results agree remarkably well with each other. The hours of mean temperature for the twelve months are 8h. 36m. A. M., and 7h. 35m. P. M., the interval between them being 11 *hours*. The interval of 11¼ hours is found between the mean hours for the six summer months, and 10½ hours for six winter months.

It is worthy of remark, that the interval between the morning and evening means, as shown by these observations, agrees with that found by the results of similar observations, made during two years, by Sir David Brewster, at Leith, in Scotland, and by Mr. Snow Harris, at Plymouth, England, although the hours of mean temperature are very different in the three cases, viz:

	Leith.	Plymouth.	Frankford.
Time of morning mean,	9h. 13m.	8h. 9m.	8h. 36m.
Time of evening mean,	8h. 27m.	7h.	7h. 35m.
Interval,	11h. 14m.	10h. 51m.	10h. 59m.

As a guide for observations on the temperature during the year, in the vicinity of Philadelphia, the hours here stated might no doubt be safely used; but it would probably be better, (in the absence of more extended observations for the mean times,) to use the hours stated in table II., as obtained from the mean of observations during shorter periods, say for the six

Day.	May. Mean. Of hourly observations.	May. Mean. Of diurnal extremes.	June. Mean. Of hourly observations.	June. Mean. Of diurnal extremes.	July. Mean. Of hourly observations.	July. Mean. Of diurnal extremes.	August. Mean. Of hourly observations.	August. Mean. Of diurnal extremes.	September Mean. Of hourly observations.	September Mean. Of diurnal extremes.	October. Mean. Of hourly observations.	October. Mean. Of diurnal extremes.	November. Mean. Of hourly observations.	November. Mean. Of diurnal extremes.	December. Mean. Of hourly observations.	December. Mean. Of diurnal extremes.	January. Mean. Of hourly observations.	January. Mean. Of diurnal extremes.	February. Mean. Of hourly observations.	February. Mean. Of diurnal extremes.	March. Mean. Of hourly observations.	March. Mean. Of diurnal extremes.	April. Mean. Of hourly observations.	April. Mean. Of diurnal extremes.	May . Mean. Of hourly observations.	May . Mean. Of diurnal extremes.
1	.....	.....	68.75	66 50	60.52	61.75	73.52	71.50	57.66	59.00	49.87	47.00	42 12	43.00	30.64	30.75	28.81	30.00	13.54	13 00	34.85	34.50	41.23	40.25	55.56	55.00
2	.....	.....	67.52	66 00	63.83	62.00	66.77	66.50	59.50	60.00	56.00	56.50	47.81	46.50	23.58	21.50	35.66	35 75	4.04	5.25	23.22	22 75	47.54	48.25	65.41	66.75
3	.....	.....	73.20	73.00	70.58	70.50	67.21	65.50	61.85	60.25	48.02	47.50	54.29	56.50	20.52	20.52	36.69	37 50	5.92	7.00	27.40	26.25	48.79	48.25	71.27	72.75
4	.....	.....	75.62	76 50	72.48	72 50	60.52	61.25	64.50	64.00	52.31	49.50	55.75	58.25	32.93	33.25	36.85	36.75	8.23	7.75	34.00	35.25	44.00	44.25	65.12	63 75
5	.....	.....	73.00	72.25	73.92	73.50	62 23	61.50	70.00	70.50	62.23	62.75	57.27	57.50	30.46	29.75	37.94	37.75	4.04	5.00	31.46	32.75	43.67	44.00	58.09	59.00
6	.....	.....	75.30	70.00	69.58	70.75	60.94	59.00	75.58	76.25	59.85	57.00	53.94	53.50	27.00	26.00	33.12	32.50	7.40	7.25	29.06	30.25	34.06	33.50	58.74	58.50
7	55.25	52.50	63.30	62.50	73.94	72.25	63.31	63.25	64.00	60.25	49.27	49.00	52 58	51.75	26.85	26.50	32.35	31.50	24.79	23.00	33.34	33.38	38.17	38.50	59.23	60.00
8	52.00	55.50	60.00	60.00	77.42	76.75	66.10	65.50	59.06	58.50	44.85	45.50	57.16	49.25	25.31	26.50	35.50	35.75	33.67	33.00	32.01	29.75	46.20	45.00	58.65	57.75
9	45.50	45.75	63.16	61.50	70.16	70.50	68.41	67.75	64 00	63.00	47.17	48.00	56.37	57.50	32.37	31.00	34.21	34.25	30.19	30.00	30.67	29 50	61.54	62.00	55.40	55.75
10	50.00	49.50	72 66	72.25	70.04	70.00	70.00	68.75	68.35	69.00	48.79	49.25	48 33	49.00	29.54	27.25	31.56	31.50	32.65	31.75	38.22	38.25	50.60	46.25	57.84	57.13
11	55.50	54.00	71.30	71.50	68.56	68.25	71.25	71.00	62.70	61.50	57.19	57 00	52.52	53.00	26.33	26.00	33.46	33.75	27.73	27.25	35.00	33.00	36.73	36.75	61.91	61.00
12	60.00	60.25	74.45	75 00	73.33	74.00	73.64	74.25	62.54	64.50	54.77	56.50	43.35	43.50	33.70	32.00	35.29	35.50	29.04	29.75	19.79	20.00	35.90	37.00	67.75	68.25
13	55.50	57.25	75.92	76.25	79.10	78.75	76.27	76.50	64.73	64.50	56.27	56.50	36.27	34.00	33.73	33.00	39.33	40.00	34.71	36.00	27.23	25.50	41.94	42 50	60.55	57.75
14	48.50	49.75	70.33	73.50	78.46	78.50	75.95	77.25	60.29	56.50	56.10	58.25	37.64	37.00	34.56	35.75	32.92	33.25	24.13	21.00	42.17	42.25	49.88	50 75	51.42	52.00
15	50.50	51.50	62.25	62 00	70.89	73.25	71.95	72.75	52.00	52 50	58.00	59.25	50.56	50.75	31.85	30.75	27.73	26.00	22.31	20.25	30.52	29.50	44.69	44.00	55.71	55.75
16	50.66	48.50	63.29	62.75	68.52	69.00	75.41	74.75	53.46	52.50	63.19	65.75	60.00	60.00	14.61	14.37	14.29	15.25	23.52	24 00	30.53	29.25	43.61	44.13	66.57	65.00
17	55.86	53.50	63.40	63.00	69.72	69.50	73.18	74.25	58.77	57.00	62.00	61.00	48.77	50.00	14.46	13.50	19.00	16.25	18.85	16.50	37.16	37.25	44.77	45.50	71.54	71.75
18	61.00	62.00	65.58	63.75	71.06	70.75	74.85	75.50	63.29	62.75	67.52	69 00	48.80	48.25	23.41	22.75	28.04	29.50	9.58	9.50	38.67	36.50	55.90	55.00	72.86	72.75
19	69.00	66.75	73.45	70.75	72.69	71.50	71.02	71.00	67.14	68.00	67.13	68 00	50.73	51.00	28.64	28.25	22.58	23.00	13.72	8.75	29.52	28.50	50.83	50.25	67.13	67.00
20	72.00	73.75	63.83	63.00	71.52	74.00	68.10	68.50	60.60	59.50	66.29	67.25	57.46	58.75	34.11	34 25	18.58	20.00	30.26	29.13	32 63	32.50	51.77	52.50	65.02	64.00
21	60.80	61.00	57.37	58.00	70.94	72.75	62.90	63.00	59.46	60.00	65.73	68.50	50.98	49.25	37.63	39.00	21.39	20.00	36.12	37.00	33 82	34.00	54.56	55.75	70.94	73.50
22	56.70	56.00	59.83	58.00	69.52	68.50	60 00	60.50	54.31	54.50	63.81	66.25	37 21	37.00	32.98	32.50	36.66	36 25	37.31	38.50	34.11	33.63	44.41	43.38	75.42	74.50
23	52.80	53.50	68.00	67.00	72.10	71.00	61.35	61.00	54 10	55.00	59.35	59.5[illegible]	5.58	34.75	22 94	23 75	20.96	18.50	36.81	36.25	30 48	31.75	48.51	46.75	79.90	76.00
24	52.75	50.50	72.14	71.75	75.02	75 00	62.90	62.75	59.81	51.25	56.90	51.25	36.45	36.5[illegible]	25 79	25.50	18.96	16 75	38.91	39.75	39.60	39.25	50.77	51.00	61.81	61.00
25	62.66	62.00	63.00	64.50	77.29	76.50	69.73	69.00	52.83	51.25	45.90	46.25	33.48	[illegible]4.50	40.25	39.25	27.85	26 00	31.60	32.25	33 65	32.50	47.45	47.00	59.46	59.25
26	71.33	72.50	67.10	67.00	75 41	75.50	69.06	67 50	54 62	54 50	46.75	47.50	31.23	32.75	45.33	46.75	22.75	24 75	21.76	22.75	30 10	30 75	61.77	60.38	56.22	56.00
27	65.45	65.00	71.30	71.25	67.33	67.25	70.42	69.50	52.58	52 50	52.29	54.00	32.27	32.25	35.21	35 00	14.18	15.25	22.48	23.00	40.42	40.75	62.34	61.25	50.05	49,75
28	70.40	67 50	65.12	68.75	67.12	65.50	74.04	75.00	57.31	58.25	52.83	54.50	34.85	35 25	30.19	32 00	9.48	11 00	20.21	20.25	43.65	43.25	58.21	57.50	57.41	57 75
29	71.66	72.50	68 48	67 75	69.40	72.00	73.66	73.50	51.56	50.75	56.42	56.75	33.44	33.25	33.16	34.50	15.29	15.75	25.63	25.13	40.52	40.25	63.17	64.00	59.02	57 50
30	67.83	66.50	63.85	61 50	72 27	73 50	66.08	65.50	45.48	45.00	62.87	64.25	28.23	27.25	36.85	37.50	27.00	27.75	.....	.....	36.01	35.50	56.40	53.25	50.16	49.75
31	67.33	65.50	.....	.....	76.44	76.00	61.71	61.50	.....	.....	52.80	52.75	.....	.....	32.80	30 25	32.83	31.75	.....	.....	41.25	41.25	.....	.....	50.78	50 25
Mean	59.18	58.71	67.78	67.16	71.58	71.65	68 46	68.20	59.43	59.10	56.20	56.60	44.98	45.05	29.90	29.36	27.68	27.72	23.07	22.72	33.58	33 54	48.65	48.30	61.83	61.51

Period of Time.	MEAN TEMPERATURE OF EACH HOUR.															
	A. M.															
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1835 May	52.36	51.44	50.44	49.20	49.28	52.12	54.32	58.24	61.36	64.32	64.70	66.34	67.08	67.90	67.88	67.04
June	60.40	59.53	58.77	58.47	60.87	62.35	65.15	67.71	70.02	72.77	74.05	74.95	75.90	76.25	76.15	76.20
July	64.48	63.66	63 00	62.83	64.22	66.11	68.16	71.58	74.06	76.01	77.37	78.71	79.90	80.48	80.20	79.60
August	62.63	61.84	61.31	60.56	62.21	63.53	65.85	68.81	70.89	72.37	73.72	75 02	75.89	76 27	76.55	76.27
September	53.03	52.62	52.17	51.27	51.33	52.50	55.27	58.78	62.12	64.00	65.72	67 15	67.88	68.52	68.52	67.77
October	50.20	50.58	49.45	49.40	49.40	49 60	51.06	53.31	56.08	58.72	61.55	64.03	65.00	65.53	65.82	64.75
November	42.40	42.00	42.08	41.78	41.66	41.60	42.22	43.97	45.15	46.70	48.12	49.28	50.02	50.78	50.41	49.67
December	27.00	26.40	26.20	26.05	25.90	25.97	26.23	27.83	29.48	31.87	34.10	35.32	35.97	36 47	35.93	34.60
1836 January	24.52	24.32	23.84	23.42	22.98	22.74	22.91	24.65	27.65	29.69	31.29	32.87	33.72	34.43	34.49	34.07
February	19.57	19.16	18.72	18.34	17.79	17.70	18.34	20.21	22.53	25.12	26.66	29.95	29.31	29.75	29.63	29.21
March	29.31	28.74	28.00	27.34	27.22	27.21	29.35	31.56	33.70	36.08	37.47	38.96	39.63	40.35	40.45	40.28
April	43.53	42.77	42.13	41.72	41.27	42.13	44.45	46 99	49.07	50.92	52.60	53.88	54.83	55.93	56.50	56.55
May	55.79	54.94	54.29	53.42	54.21	55.63	58.16	60.69	62.84	64.05	66 10	67.73	68.87	69.52	70 04	69.94
Summer, 1835. (June, July, August,)	62.50	61.68	61.03	60.62	62.43	64.00	66.39	69.37	71.66	73.72	75.05	76.22	77.23	77.67	77.63	77.36
Autumn, 1835. (September, October, November,)	48.54	48.40	47.90	47.48	47.46	47.90	49.52	52.02	54.44	56.47	58.46	60.15	60.97	61.61	61.58	60.73
Winter, 35 & 36. (December, January, February,)	23.70	23.29	22.92	22.60	22.22	22.14	22.49	24.23	26.55	28.89	30.68	32.05	33.00	33.55	33.45	32.63
Spring, 1836. (March, April, May,)	42.88	42.15	41.47	40.83	40.90	41.66	43.99	46.41	48.54	50.35	52.06	53.52	54.44	55.27	55.66	55.59
Six Summer months. May to October.	57.18	56.61	55.86	55.29	56.22	57.70	59.97	63.07	65.75	68 03	69.52	71.03	71.94	72.49	72.52	71.94
Six Winter months. November to April.	31.06	30.57	30.16	29.78	29.47	29.56	30.58	32.53	34.59	36.72	38.37	39.54	40.58	41.28	41.28	40.73
Twelve months. May to April.	44.12	43.59	43.01	42.53	42.84	43.63	45.27	47.80	50.18	51.91	53.94	55.29	56.26	56.89	56.87	56.33
Deviations from the mean of the year.	— 5.09	— 5.62	— 6.20	— 6.68	— 6.37	— 5 58	— 3.94	— 1.41	+ 0.97	+ 2.70	+ 4.73	+ 6.08	+ 7.05	+ 7.63	+ 7.66	+ 7.12
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4

Hourly Mean Temperature, &c.

P. M.								General Mean.		Extremes.					Hour of	
								Of hourly observations.	Of diurnal extemes.	Minima.		Maxima.		Difference.	Minima.	Maxima.
5	6	7	8	9	10	11	12			Date.	Degree.	Date.	Degree.		A. M.	P. M.
66.12	64.00	61.26	58.40	56.96	55.76	55.16	54.20	59.18	58.71	24th	36.	20th	86.5	50.5	4.	2.
75.40	73.03	70.47	67.63	64.90	63.30	62.00	60.86	67.78	67.16	22nd	44.	4th	87.	43.	4.	2.
78.58	76.34	73.61	70 77	68.74	67.58	66 84	65.90	71.58	71.65	2nd	48.	13th	89.5	41.5	4.	2.
75.08	72.74	70.19	67.19	65.90	64 68	63.61	62.98	68.46	68.20	5th	49.	14th	85.5	36.5	4.	3.
66.00	63.58	59.43	57.58	56.87	55.50	54.47	53.50	59.43	59.10	30th	36.	6th	86.	50.	4.	2 and
62.82	59.73	56.76	55.34	53.71	52.71	52.03	51.12	56.20	56.60	8th	33.	20th	76.50	43.5	4 and 5.	3.
48.38	45.67	44.28	43.52	43.10	42.62	42.23	42.03	44.98	45.05	30th	15.50	15th	67.	51.5	6.	2.
32.79	30.72	29.92	29.22	28.58	27.88	27.32	27.48	29 90	29.36	17th	6.5	25th	48.	41.5	5.	2.
32.81	29.68	28.01	27.20	26.62	25.77	25.39	24.97	27.68	27.72	29th	2.5	2nd	48.5	46.	6.	2.
27.85	25.62	23.57	22.64	22.00	21.14	20.48	20.38	23.07	22.72	6th	— 7.	22nd	48.	55.	6.	2.
39.56	37.95	34.99	33.61	32.50	31.50	30.71	30.28	33.58	33.54	3rd&13th	11.5	27th	53.5	42.	6.	3.
55.97	54.12	50.72	48.55	47.05	45.83	45.35	44 53	48.65	48.30	7th	26.	26th	77.25	51.25	5.	4.
68.98	67.09	64.56	61.58	59.95	58.63	57.63	56.66	61.83	61.51	14th	39.	22nd	87.	48.	4.	3.
76.35	74.04	71.42	68.53	66.51	65.19	64.15	63.25	69.40	69.00	June 22nd	44.	July 13th	89.5	45.5	4.	2.
59.07	56.33	53.49	52.15	51.23	50.28	49.57	48.88	53.54	53.58	Nov. 30th	15.5	Sept. 6th	86.	70.5	5.	2.
31.15	28.67	27.17	26.35	25.73	24.93	24.40	24.28	26.88	26.60	Feb. 6th	— 7.	January 2nd	48.5	55.5	6.	2.
54.84	53.05	50.09	47.91	46.40	45.32	44.56	43.82	48.02	47.78	March 3rd&13th	11.5	May 22nd	87.	75.5	4.	3.
70.67	68.24	65.19	62.82	61.18	59.92	59.02	58.01	63.77	63.57	Oct. 8th	33.	July 13th	89.5	56.5	4.	3.
39.56	37.29	35.25	34.12	33.31	32.45	31.92	31.62	34.64	34.45	Feb. 6th	— 7.	April 26th	77.25	84.25	5.	2 and 3
55.11	52.77	50.27	48.47	47.24	46.19	45.47	44.85	49.21	49.01	Feb. 6th	— 7.	July 13th	89.5	96.5	4.	2 and 3
+ 5.90	+ 3.56	+ 1.06	— 0.74	— 1.97	— 3.02	— 3.74	— 4.36									
5	6	7	8	9	10	11	12									

Hour of Daily Mean.			
n.	Maxima.	Temperature.	
.	P. M.	A. M.	P. M.
	2.	8h. 18m.	7h. 44m.
	2.	8	7 58
	2.	8	7 43
	3.	7 53	7 35
	2 and 3.	8 12	7
5.	3.	9 3	7 24
	2.	8 51	6 30
	2.	9 10	7
	2.	9	7 25
	2.	9 12	7 32
	3.	8 56	8 02
	4.	8 48	7 57
	3.	8 31	7 55
	2.	8	7 45
	2.	8 38	7
	2.	9 8	7 21
	3.	8 45	7 57
	3.	8 16	7 30
	2 and 3.	9	7 30
	2 and 3.	8 36	7 35

summer months 8¼h. A. M. and 7½h. P. M.; for the six winter months 9h. A. M. and 7½h. P. M. To obtain further data for ascertaining the hours of daily mean temperature, it is not necessary to embrace the whole day in our observations, for the results in Table I. furnish evidence of a striking fact, which enables us to determine the mean temperature of the day, by observations of the maximum and minimum, which are little liable to error, and which may even be made by means of self-registering thermometers, if the indications of those instruments can be relied on. The fact alluded to is that the *mean of the maximum and minimum of each day is very nearly the mean temperature of the whole day.*

By examining Table II., where the general means of hourly observations and the means of diurnal extremes are exhibited together, we see that this holds not only for the whole year, but for each of the periods of six and three months, into which the year is distributed, and also for each separate month; and still further, by Table I., we see that this agreement extends, with little variation, to the results of each day's observations.

Having then a method of ascertaining the mean temperature of the day, by two observations, it will be sufficient, in order to determine the hours of mean temperature, to make two or three observations in the morning and evening, at short intervals, about the time when we know that the mean temperature must occur, and the two observations which agree with each other, and with the mean of the maximum and minimum, will indicate the time of mean temperature.

Since my hourly register was discontinued, I have made observations according to this method, taking as my guide for the hours of observation, the results previously obtained. Thus for the month of June, 1836, observations were made at 4 and 8, A. M., and at 2 and 8, P. M., the results of which are perfectly satisfactory: they are as follows, viz:

Mean temperature at 4 A. M. - -	58.90
——————— 8 A. M. - -	63.87
——————— 2 P. M. - -	70.33
——————— 8 P. M. - -	64.18
General mean of four daily observations, -	64.33
General mean of diurnal extremes, - -	64.61

Comparison of the Mean Temperature of each Hour, and each similar pair of Hours, with the General Mean of the Year.

The bottom line in Table II. exhibits the deviation of the mean temperature of each hour from the mean of the year: the differences are marked negatively when the mean of the year exceeds that of the hour, and positively in the contrary case; the first occurs between 8 P. M. and 8 A. M., both inclusive, the greatest difference during that time being 6°.68; the second between 9 A. M. and 7 P. M., inclusive, the greatest difference being 7°.68. This line of differences might be used for ascertaining the mean temperature by one observation, applying to the observed temperature the correction from the table, by changing its sign. But for this purpose a better approximation may be made from observations made at any similar *pair of hours*, by applying the proper correction from the following table.

Table IV. shewing the relation of the Mean Temperature of each pair of Hours, to that of the whole year.

Pair of Hours.	1	2	3	4	5	6
Mean temperature.	50.19	50.24	49.94	49 43	48.98	48.20
Deviation,	+0 98	+1.03	+0.73	+0.22	−0.23	−1.01
Pair of Hours.	7	8	9	10	11	12
Mean temperature,	47.77	48.13	48.71	49.05	49.70	50.07
Deviation,	−1 44	−1.38	−0.50	−0.16	+0.49	+0.86

From this table it appears that the mean temperature of the six pairs of hours from 11h. to 4h. inclusive, exceeds the mean temperature of the year, the greatest difference being 1°.03; and the mean temperature of the six pairs, from 5h. to 10h. inclusive, is less than the mean of the year, the greatest difference being 1°.44. The mean temperatures of 4h. and 4h., and 10h. and 10h. approach nearest to the general mean of the year; therefore, according to these results, those would be the proper pairs of hours for making observations for the mean temperature.

Discussion of the curves of Mean Hourly Variation of Temperature.

The curve projected for the mean hourly temperature, during the twelve months, is that which will be first discussed. It naturally divides itself into four branches, viz:

1. The morning branch, ascending from the minimum to the line of mean temperature.
2. The noon branch ascending from the line of mean temperature to the maximum.
3. The afternoon branch descending from the maximum to the line of means.
4. The night branch, descending from the line of means to the minimum.

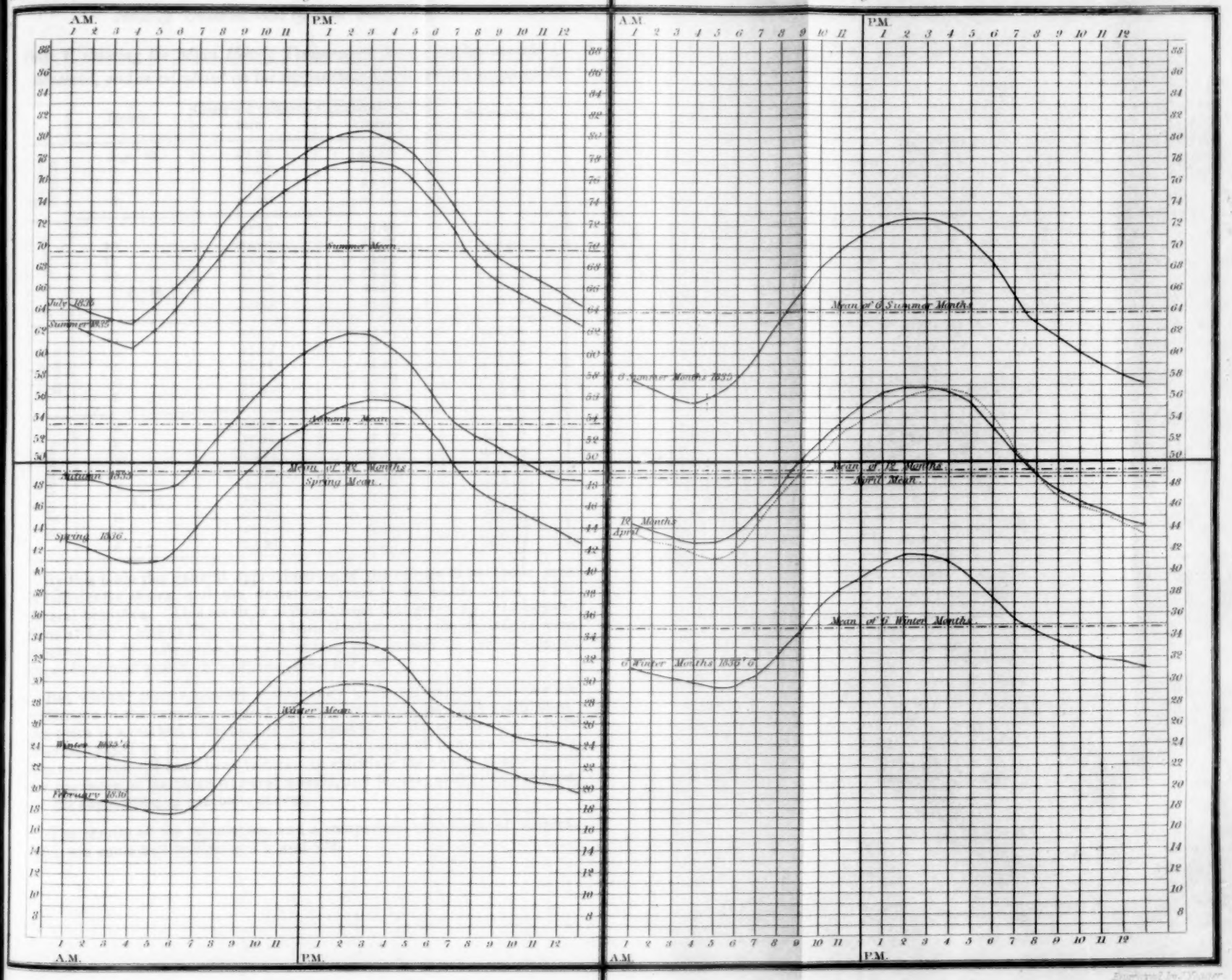
Sir David Brewster and Mr. Harris having discussed the curves given by their observations, on the supposition of their being parabolas, each branch having a distinct type, I have applied the same method to the curve under consideration.

Regarding then each of the four branches as an arc of a separate parabola, the vertex of which is at the point of maximum or minimum respectively, we have in each curve the abscissa and ordinate of the point in which it intersects the line of mean temperature, and therefore we can readily calculate the intermediate points, or the temperature of each hour, on the supposition of the curves being parabolas.

The following have been assumed as the data of the calculation, viz:

Minimum temperature	- -	at $4\frac{1}{2}$ A. M.	42.5
Morning mean "	- -	at $8\frac{1}{2}$ A. M.	49.2
Maximum "	- -	at $2\frac{1}{2}$ P. M.	56.9
Evening mean "	- -	at $7\frac{1}{2}$ P. M.	49.2

These terms, differing slightly from those given in Table II., are taken for greater convenience, as approximating sufficiently to the results of observations. Table V. gives the results of the calculated and observed temperature for each hour, together with the differences.



Engraved for Frank. Inst.

Table V. showing the Mean Hourly Temperature during twelve months as observed, and as calculated on the supposition that the curves are parabolas

	Hours.	Observed temperature.	Calculated temperature.	Differences.
Morning Branch.	5 A. M.	42.84	42.60	+ 0.24
	6	43.63	43.44	+ 0.19
	7	45.27	45 12	+ 0.15
	8	47.80	47.63	+ 0.17
Noon Branch.	9	50.18	50.43	— 0.25
	10	51.91	52.57	— 0.66
	11	53.94	54.28	— 0.34
	12	55.29	55.56	— 0.27
	1 P. M.	56.26	56.42	— 0.16
	2	56.89	56.85	+0.04
Afternoon Branch.	3	56.87	56.82	+ 0.05
	4	56.33	56.21	+ 0.12
	5	55.11	54.97	+ 0.14
	6	52.77	53.13	— 0.36
	7	50.27	50.66	— 0.39
Night Branch.	8	48.47	48.50	— 0.03
	9	47.24	47.17	+ 0.07
	10	46.19	46.01	+ 0.18
	11	45.47	45.01	+ 0.46
	12	44.85	44.18	+ 0.67
	1 A. M.	44.12	43.52	+ 0.60
	2	43.59	43.02	+ 0.57
	3	43.01	42.69	+ 0.32
	4	42.53	42.52	+ 0.01

By this table the general approximation of the curves to parabolic arcs is sufficiently shown, and the deviations seem to be nearly equal in the several branches. This result is different from that given by the observations at Leith, and at Plymouth, in both of which cases the deviations were greatest in the afternoon branch; indeed that branch in the Plymouth curve is almost exactly a right line, after 3 P. M.

But without more extended observations here, we cannot consider the difference in the rate of variation of temperature to be fully established. As there is a marked difference in the character of the summer and winter curves, caused by the difference in the daily range of temperature during the two seasons, I have been induced to calculate the hourly temperatures for the mean of the three warmest months, and for that of the three coldest, on the supposition of parabolic curves.

The results of the calculation, and a comparison with those of observation, are contained in Tables VI. and VII.

Table VI. showing the Mean Hourly Temperature during the three summer months, viz: June, July, and August, 1835, *as observed, and as calculated on the supposition of parabolic curves.*

	Hours.	Observed temperature.	Calculated temperature.	Differences.
Morning Branch.	4 A. M.	60.62	60.62	0.00
	5	62.43	61.17	+ 1.26
	6	64.00	62.82	+ 1.18
	7	66.39	65.57	+ 0.82
	8	69.37	69.42	— 6.05
Noon Branch.	9	71.66	71.77	— 0.11
	10	73.72	73.73	— 0.01
	11	75.05	75.30	— 0.2
	12	76.22	76.48	— 0.25
	1 P. M.	77.23	77.26	— 0.06
	2	77.67	77.65	+ 0.02
Afternoon Branch.	3	77.63	77.64	— 0.01
	4	77.36	77.02	+ 0.34
	5	76.35	75.82	+ 0.53
	6	74.04	74.02	+ 0.02
	7	71.42	71.62	— 0.22
Night Branch.	8	68.53	68.92	— 0.39
	9	66.51	66.99	— 0.48
	10	65.19	65.30	— 0.11
	11	64.15	63.87	+ 0.28
	12	63.25	62.70	+ 0.52
	1 A. M.	62.50	61.79	+ 0.71
	2	61.68	61.14	+ 0.54
	3	61.13	60.75	+ 0.28

From Table VII. it appears that the agreement of each branch of the winter curve to a parabola is, with one exception, sufficiently near to justify the supposition of the variations of temperature being represented by parabolic abscissæ, the single exception, (at 6 P. M.) results from an accidental anomaly in the mean results for the month of January; for the January and December curves meet at 5 P. M., although in the rest of their course they are nearly parallel to each other, and to the curve for February. I apprehend that this anomaly may arise from an error of observation, as the hour from 5 to 6 P. M. is that during which the thermometer was removed, in January, to the night station

Table VII., showing the Mean Hourly Temperature during the three winter months, viz: December, January, and February, 1835–6, as observed, and as calculated on the supposition of parabolic curves.

	Hours.	Observed temperature.	Calculated temperature.	Differences.
Morning Branch.	6 A. M.	22.14	22.14	0.00
	7	22.49	22.62	— 0.13
	8	24.23	24.08	+ 0.15
	9	26.55	26.50	+ 0.05
Noon Branch.	10	28.89	28.88	+ 0.01
	11	30.68	30.75	— 0.07
	12	32 05	32.14	— 0.09
	1 P. M.	33.00	33.08	— 0.08
	2	33.55	33.54	+ 0.01
Afternoon Branch.	3	33.45	33.53	— 0.08
	4	32.63	32.95	— 0.32
	5	31.15	31.40	— 0.25
	6	28.67	30.07	— 1.40
	7	27.17	27.77	— 0.60
Night Branch.	8	26 35	26.30	+ 0.05
	9	25.73	25.51	+ 0.22
	10	24.93	24.80	+ 0.13
	11	24.40	24.18	+ 0.22
	12	24.28	23.64	+ 0.64
	1 A. M.	23.70	23.18	+ 0.52
	2	23 29	22.81	+ 0.48
	3	22 92	22.51	+ 0.42
	4	22.60	22.37	+ 0.23
	5	22.22	22.18	+ 0.04

The agreement of the observed and calculated temperatures in Table VI. also tends to confirm our supposition, except with regard to the morning branch. This exception might have been anticipated by inspection of the curve as projected, from which it is evident that the increments of temperature after sun-rise, in the summer, are too great to be represented by the abscissæ of equal parabolic arcs. As this branch of the subject requires, more than any other part of it, the application of more extended observations, I shall not pursue the investigation further at this time, in the hope that some persons favourably situated at one or more of our military or naval stations, may be induced to supply us with additional data for confirming or correcting the laws of variation of temperature, which have been laid down in this paper.

Frankford Arsenal, November, 1836.

Third Report of the Joint Committee on Meteorology, of the American Philosophical Society and the Franklin Institute of the State of Pennsylvania, for the Promotion of the Mechanic Arts.

In our two previous Reports we gave an account of nine storms, in all of which the wind blew towards the storm in its borders.

Two very remarkable storms have occurred since; one commenced on the 23rd of May, and continued to the 7th of June; the other occurred on the night of the 19th and the day of the 20th of June. Immediately after the

termination of these storms, the committee addressed circulars to a great many individuals throughout the United States, requesting an account of them, particularly with regard to the rain, and the strength and direction of the wind. Our inquiries were not in vain. We received very satisfactory replies from many in the region of the storms, and beyond their boundaries. It would be highly desirable to give the documents to the public, entire, but our present means will not permit.

It is hoped that when government shall become acquainted with the important discoveries already made, and the absolute necessity of combined and simultaneous exertions, beyond the reach of individuals, their liberality will be cheerfully extended to the promotion of this science, in our widely extended country.

In the mean time, we must content ourselves by giving a few general results, as we did in our previous reports.

In the first place, we remark a very striking difference between the first of the two storms mentioned above, and all the winter storms investigated before in our reports; all the winter storms as well as the tornados or land spouts in the summer, seem to travel from a point south of west, while this long continued storm was nearly stationary, inclining, indeed, a little towards the south-west, as it continued to rain in N. C. and S. C. some days after it ceased at Philadelphia. The Alleghany Mountains seem to have been near the centre of the rain, extending from the western parts of N. York to S. Carolina. The rain was copious as far west as Cincinnati and Lexington, Ky., and as far east as the shores of the Atlantic, hardly reaching Illinois, and extending but little way into the Atlantic, and not prevailing much as far N. E. as Massachusetts.

Now, in Massachusetts. Connecticut, and New York, the wind was constantly blowing from the N. E. during the whole period of the storm. In Charleston, S. C., constantly from the S. and S. E. In the interior parts of the storm, the wind was variable; the prevailing winds, however, in the northern parts of Ohio being from the N., in Illinois from the W., and in Alabama there seems to have been nothing remarkable—no N. E. storm occurred, but the direction of the wind is not given.

It also appears by the log books of several masters of vessels who left the Gulph of Mexico about the beginning of this storm, and arrived at Philadelphia about the end of it, that they had the wind constantly from the S. W. and S. and S. E. fresh the whole way, gradually passing the south and nearing the east as they approached to Philadelphia.

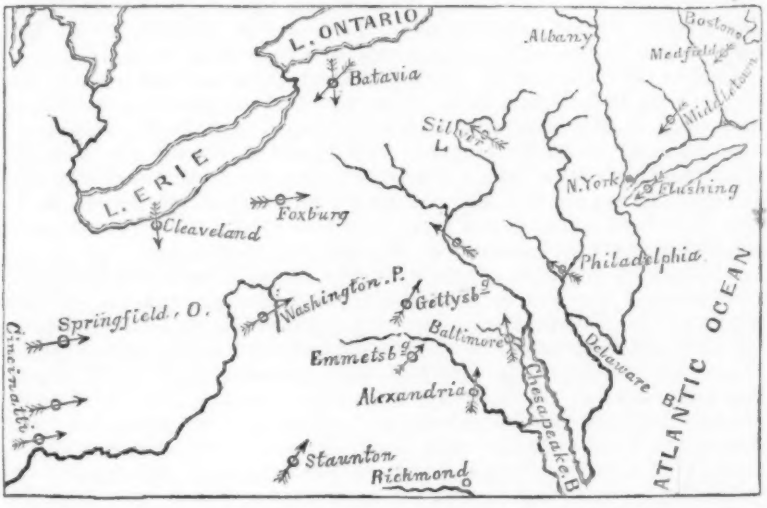
Thus it appears that on the N. E. and E., S. and S. W. the wind was constant, for at least fourteen days towards a great rain, and that on the other part of the circle, even within the boundaries of the rain, the wind, though variable, prevailed in a direction towards the centre of the storm.

In this storm then, as in the nine investigated before, the wind blew towards the centre, and consequently upwards in the middle—and outwards above—at least in Massachusetts. Mr. Daniel C. Sanders, of Medfield, 17 miles S. W. of Boston, says: "often there were three strata of clouds, the upper one very high, moving from the west, nearly opposite to the lower stratum. The middle one was very changeable in its direction."

And also at Bennington, Vermont, Mr. Jonathan Hunt says: "In almost all violent storms from the east, there is an upper current from the west."

There is therefore the strongest reason to believe that rain is caused by the cooling produced by the rarefaction of the air in its upward motion in the centre of the storm.

The storm which commenced on the night of the 19th June is not less remarkable than the one just described. It seems also to have traveled S. or S. W., for on the night of the 19th, and the next day, the rain was greatest at Silver Lake, in the northern part of Pennsylvania, and on the night of the 20th, and the next day, it was greatest at Baltimore, and it did not reach Hawsburg, Rappahannock county, Va., till the 21st, when it rained very heavily, the wind having veered round to the N. E. At Staunton, Va., it was clear all day the 21st and 22d, till evening, and the N. E. storm did not set in till the 24th.



In the wood cut we have given the direction of the wind by means of arrows at all the places from which we have any accounts. On the 20th of June, there fell nearly three inches of rain, including that of the preceding night, at Silver Lake. Much more rain fell here than at any of the surrounding places of observation. There was but little at Foxsburg, Gettysburg, and Harrisburg, and it did not commence at Baltimore till 7h. 30m. P. M., nor at Emmettsburg till 4 P. M., nor at Philadelphia till 5h. 10m. P. M.

By casting the eye on the wood-cut, it will be seen at a glance that the wind blew on all sides towards the point of greatest rain.

But what is not a little remarkable, the wind was much more violent all round the borders of the storm, than near the centre.* At Harrisburg and Gettysburg it was gentle, and at Emmettsburg it was tempestuous. It is true it did not begin to be tempestuous till 4 P. M., and at Philadelphia it did not begin to blow very hard at the surface of the earth, till about 11 A. M. At 7 A. M. it was very calm, though the low clouds were flying with great velocity from the S. E., exactly towards the region of the great rain.

It is also worthy of particular remark, that the wind at Emmettsburg was N. W. on the 21st, blowing towards a region where it rained that morning and the preceding night, so much as to do great mischief, and even as near to Emmettsburg as Baltimore, it rained in that time 1-7 inches.

* It has since been ascertained that during the day of the 20th, the wind at Silver Lake was so variable that it was difficult to know from what point it prevailed most.

This rain reached Emmettsburg, but was small in quantity, viz. $\frac{36}{100}$ of an inch. The wind on this day, at Baltimore, varied from S. E. to N. E. It was, therefore, part of the time, exactly opposite to the wind at Emmettsburg.

Another remarkable feature of this storm is, that it was preceded the day before with thunder-gusts, on the N. E. N. and W., and probably on the S. E., as the temperature fell very suddenly at Philadelphia, as soon as the wind changed to south-east, about 11 A. M. The sudden depression of temperature can hardly be accounted for, except on the supposition that a thunder storm took place during the preceding night, S. E. of Philadelphia. The temperature had not changed at Harrisburg at 1 P. M., nor at Emmettsburg at $2\frac{1}{2}$, where the wind continued all day from the S. W.

Besides these two storms, we may mention one which took place on the night of the 10th March, 1836. The centre of greatest rain appears to have been at Providence, R. I., where it began at 6 P. M., and rained most violently till twelve at night. The papers of the day give accounts of great damage done by the floods near Providence: and they state that the wind sprung up and blew violently from the S. E. at Bristol, R. I., some time in the evening, and raged from that quarter till five next morning, and then changed round to S. W., and continued strong.

At Flushing, Long Island, the wind was almost calm at $5\frac{3}{4}$ P. M., but about seven it rose from S. W. and blew hard all night, and till ten next morning. At Philadelphia it was very calm and foggy all the evening, till about eleven, when the wind rose suddenly and violently from the S. W., and blew a hurricane nearly all night, changing round to N. W. at four next morning. It is worthy of particular remark, that at Flushing the wind began to blow towards the point of greatest rain about four hours sooner than it did at Philadelphia, about 100 miles more distant from the centre of the storm. This is in remarkable accordance with the fact detailed above, concerning the time the wind set in at Philadelphia from the S. E. on the morning of the 20th June, towards a very great rain which had been going on then for eleven or twelve hours at Silver Lake, and in that vicinity.

From all these facts, in connexion with those detailed in our previous reports, it is, we think, abundantly proven, that the air moves inwards towards the centre of great rains, and consequently upward in the region of the cloud. Nor is this inward motion difficult to account for. It has been long known that the barometer stands low in the middle of great storms, and nothing is more plain than that the air will run on all sides towards the point where the barometer stands lowest, with a velocity proportional to the square root of the depression. And as this air mounts upwards over the point where the barometer stands lowest, a condensation of the vapour must take place from the cold produced by diminishing pressure as it ascends. Now, the chairman of this committee has shown by calculation from acknowledged data, that for every pint of water which is formed by condensation of vapour, the cloud itself is expanded 7600 pints by the latent caloric given out at the moment of condensation. Thus will the upward motion in the cloud be continued as long as air highly charged with vapour runs in below.

It is also easy to explain why the base of the cloud, during this rapid motion of the air upwards, remains nearly at the same level. For so long as the dew-point of the air at the surface of the earth, which supplies the ascending column with vapour, remains the same, if the tempera-

ture of the air is the same also, it will have to ascend to the same height, before cold enough is produced by expansion to cause condensation of the vapour. This height is found to be about 100 yards for every degree between the temperature of the air and the dew-point, unless when the cloud becomes of great prependicular depth, when the base sinks a little from the levity of the cloud.

The quantity of depression of the vapour as well as of the air, after due allowance is made for the fall of the dew-point from the expansion, is nearly 400 yards for a depression of the barometer one inch, on the supposition that the temperature of the air sinks 4° for a diminution of pressure equal to an inch of mercury.

A depression of near two and a half inches has been recorded in a spout accompanied with hail nine inches deep: hence the base of the cloud would descend in the centre near 1000 yards; and of course, if the dew-point and temperature of the air were not more than 10° apart, the cloud would reach the earth, and exhibit itself in the form of an inverted cone, expanding as it goes up, and by its rapid motion carrying up large drops of rain above the region of perpetual congelation, and throwing them out at the sides, in the form of *hail.*

From the principles here developed, it will be easy, when a great storm springs up, or comes within disturbing influence, to tell in what direction it is raging; for the direction of the wind points it out. An exception to this general principle was mentioned and explained in our last report. The connexion also between volcanos and rains is no longer mysterious: for an upward motion of the air is produced and kept up by the volcano, the result of which must be a condensation of vapour, unless the dew-point is very low. So powerful is this tendency, that in South America a dry season is sometimes changed into a rainy one, by the bursting out of a volcano. From these brief hints, we trust it will be acknowledged that something has been gained explanatory of the phenomena in question. But we must not stop here; it is not enough to know *where* it is raining at a given time; we must know *when* it will rain where we are. For this purpose it is of primary importance to know the direction in which storms move, and also their velocity in all the different seasons of the year.

We would suggest as the most effectual, and perhaps the only, means of obtaining this end, an appropriation by government for the purchase of meteorological instruments, to be presented to those academies, schools and colleges, that would pledge themselves to keep a journal of the weather, according to a prescribed plan, for five years; and send a monthly statement to a meteorologist, to be appointed by the government. If instruments were thus furnished for 100 observers, it is altogether probable 200 more would volunteer their services, knowing that their labours would be one hundred fold more valuable in combination with others than they had hitherto been.

With 300 observers, properly located, no storm could spring up within, or enter the United States, without being constantly under the eye of at least two observers. And thus its extent, its progress, and the direction of the wind in its borders, would be fully known. Until this shall have been effected by government, we entreat every gentleman to whom the report is sent, to consider it a patriotic duty to furnish the means of enabling at least one faithful observer of the weather, to transmit a series of observations monthly, to Wm. Hamilton, Esq., Actuary of the Franklin Institute, Philadelphia.

Mechanics' Register.

THE PATENT OFFICE.

Our readers need not be informed of the great national loss consequent upon the burning of the Patent Office, a circumstance which will materially influence, for a time at least, the contents of this Journal. The editor resides in the vicinity of that office, and his danger from the fire was imminent; but his dwelling, with his books and papers, were preserved, although with some disarrangement of the latter; his papers and notes relating to patents were, however, in a desk in the Patent Office, and of course, shared the general fate of its contents. On the first moment of alarm all access to that office was rendered impracticable from the dense smoke with which its stair case and passages were filled, even before the fire was visible. The monthly list of Patents, with the Editor's remarks, must, at present, be discontinued, but they will be resumed in due season, after the necessary progress has been made in the business of the office. In the meantime a series of specifications of recent Patents, of which the Editor has copies, will, in part, supply the place, and to these will be added a number of English Patents, the publication of which has been deemed of much importance, but has been postponed from want of sufficient room.

The letters of enquiry which the editor has received since the fire, have been numerous, and replies to them have absorbed a large portion of his time, profitably, he hopes, to others, although, so far as money is concerned, but little so to himself. But for this, his pen would have been devoted to a notice of some two or three books on hand, and to other matters which he wishes to spread out upon his pages.

The great question now is, what can be done for the restoration of the Patent Office? To this question the best reply that can be offered at the present moment, is contained in the subjoined Report, and Bill; the latter of which will undoubtedly be enacted into a law, with such modification in its provisions as may appear proper upon a due consideration thereof by the National Legislature; and we have but little doubt that in the next numbe. of this journal, we shall be able to present it in the form of a law, as the subject is one which requires and will command, early attention.

Mr. Ruggles' Report to the Senate, with a Bill.

The special committee appointed to examine and report the extent of the loss sustained by the burning of the Patent Office, and to consider whether any, and what, measures ought to be adopted to repair the loss, and to establish such evidence of property in patented inventions as the destruction of the records and drawings may have rendered necessary for its security, submit the following report:

In examining the subject referred to them, the committee have been deeply impressed with the loss the country has sustained in the destruction, by the fire of the 15th December, of the records, originals, drawings, models, &c., belonging to the Patent Office. They not only embraced the whole history of American invention for nearly half a century, but were the muniments of property of vast amount, secured by law to a great number of individuals both citizens and foreigners, the protection and security of which must now become seriously difficult and precarious.

Every thing belonging to the office was destroyed—nothing was saved. There were one hundred and sixty-eight large folio volumes of records, and twenty-six large portfolios, containing nine thousand drawings, many

of which were beautifully executed and very valuable; there were also all the original descriptions and specifications of inventions, in all about ten thousand, besides caveats, and many other documents and papers.

There were also two hundred and thirty volumes of books belonging to the Patent Office library, the cost of which was $1,000. Some of these were procured prior to the passage of the act of July 4, 1836, making an appropriation of $1,500 for purchasing a library of scientific works. Others were procured subsequently, for which $320 of that appropriation was expended.

The model-cases, press and seals, desks, book-cases, and other furniture and effects belonging to the office, were estimated at $6,600.

The Patent Office contained also the largest and most interesting collection of models in the world. It was an object of just pride to every American able to appreciate its value as an item in the estimate of national character, or the advantages and benefits derivable from high improvement in the useful arts—a pride which must now stand rebuked by the improvidence which exposed so many memorials and evidences of the superiority of American genius to the destruction which has overtaken them.

The number of models was about seven thousand. Many of them displayed great talent, ingenuity, and mechanical science. The American inventions pertaining to the spinning of cotton and wool, and the manufacture of fabrics, in many respects exceed those of any other nation, and reduced so much the expense of manufacture, that the British manufacturers were reluctantly obliged, at the expense of a little national pride, to lay aside their own machinery and adopt our improvements, to prevent our underselling them even in their home market. In this department were the inventions of Browne, Thorpe, Danforth, Couilliard, Calvert, and some others. The beautiful operative model of Wilkinson's machine for manufacturing weavers' reeds by one operation was considered one of the most ingenious mechanical combinations ever invented. Of this character was Whittemore's celebrated machine for making wool cards. There were several models of valuable improvements in shearing and napping cloth, patented to Swift, Stowell, Dewey, Parsons, Daniels, and others.

In another department were several models of machines for manufacturing cut and wrought nails. The machinery for this purpose, which has reduced so much the price of that important article, was of purely American origin, and was invented by Briggs, Perkins, Reed, Odiorne, and several others.

The models of improvements in grist-mills, saw-mills, water-wheels, &c. were numerous.

The application of steam power to the driving of all kinds of machinery for propelling boats, locomotives, mills, and factories, has brought out a great number of American inventions and improvements, displaying a degree of talent, ingenuity, and science highly creditable to our country. Some of the models in this department were very valuable. America claims the honour (contested, indeed, by England) of the first successful attempt to apply the power of steam to the propelling of vessels. The name of Fulton is associated with one of the noblest efforts of genius and science. It has often been regretted that no model was preserved of his steamboat, which was the first to demonstrate the practicability of making steam subservient to the purposes of useful navigation. There was, however, deposited in the Patent Office a volume of drawings elegantly executed by his own hand,

delineating the various parts of the machinery he employed, and embracing three beautiful representations of his steamer making its first triumphant struggle against the opposing current of the Hudson. The steamer was represented passing through the Highlands, and at two or three other interesting points on the river, with a beautiful sketching of the surrounding scenery smiling as it were at the victory which science and art had at last achieved over the power of the winds and the waters, and at the opening era of steam navigation, the benefits of which have since been so widely diffused. It contained also an account of his experiments on the resistance of fluids, and various estimates of the power required to propel vessels of various tonnage and form through the water at a greater or less speed. This volume, which should have been preserved among our choicest archives, shared the fate of every thing else in the office. What sum would be too great to be expended in replacing it?

The department of agriculture contained a great number of models of highly useful improvements in the implements of husbandry. The number of inventions which had for their object the advancement of the agricultural interests, was about fifteen hundred; those which pertained to navigation were little short of a thousand. The inventions and improvements in factory machinery, and in the various manufactures, were upwards of two thousand. In the common mechanical trades there were as many more. It were vain to attempt to enumerate or classify them within the reasonable space of a report of committee. There was no art or pursuit to which ingenuity and invention had not lent their aid.

That this great national repository should have received so little consideration heretofore as to be left so long exposed to conflagration, which has at last swept every vestige of it from existence, cannot be too deeply deplored. But the reproach does not rest at the door of the present Congress. The act passed at its first session, reorganizing the office, containing many important provisions for its management, and the appropriation for erecting a fire-proof building, for the accommodation and preservation of the records, models, &c., which is now under construction, attest the interest inspired by, and the attention devoted to, it, though, unfortunately, too late to rescue it from destruction.

That the benefit of such an institution is limited to the mechanic arts and manufactures, or that it is confined to any particular section of the Union, is an erroneous idea. Its influence is felt in every branch of national industry, and no one section of the country can justly be said to derive less advantage from it than another. The idea is equally erroneous that such institutions are established for the benefit of patentees only. The advancement of great national interests is the first object of the patent laws of all nations where they exist. The specifications, models, and drawings, are required that, after the patent-term shall have expired, the public may have the benefit of a disclosure of the invention, so full and intelligible that any one can apply its principles to practical use, or make them the foundation of further improvements.

It is a still more erroneous idea that no drawings or models of new inventions are of use to the public, unless the machinery they represent is susceptible of a practical application to the use designed. Mechanical science, like all others, is matured and perfected by degrees, and by calling to its aid the investigations and ingenuity of various minds. Most inventions are but the foundation of progressive improvements. It is necessary to know what has been done, in order to know what remains to be accomplished. Every

age avails itself of the experience and discoveries of that which has preceded it; were it otherwise, knowledge would be stationary, and every generation, instead of being wiser than others gone by, would be employed in learning over again what had been acquired before. The drawings and models of even those inventions which are imperfect, or incapable of producing the desired effect, serve to show how far others have progressed, and either furnish hints for the full accomplishment of the design, or as beacons to enable others to avoid fruitless labour and expense. Whoever would attempt to improve the arts, must begin where others have left off: hence, the model rooms of the Patent Office were constantly visited by men of genius and science from all sections of the country, and from Europe, where they were able at once to discover how far American invention had gone, and where they frequently derived important hints from inventions and contrivances of apparently but little value.

They would seem, also, to be almost indispensable, in deciding upon new applications for patents, to enable the proper officers to judge of the originality of the invention, and to prevent the issuing of interfering patents. It often requires a very close examination of the principles of a machine, and a careful comparison of models and drawings, to discover how far they interfere with previous inventions. The provision interdicting the granting of patents for what is not new and original, is the most valuable feature of the act of July last. But it will be impossible for the Commissioner to administer the law in that particular, according to its intent, without models and drawings of inventions previously patented. The consequence would be in effect, the restoration of a great portion of the evils of the former system in multiplying conflicting rights, leading to much perplexity and expensive litigation. Much of the ground traveled over in the last forty years would have to be traveled over again before the point could be reached at which we had arrived prior to the late conflagration.

The committee therefore believe that it is important to the interests of the country, as well as to the security of individual rights, that measures be immediately adopted to replace, as far as practicable, the records, drawings, and models which have been destroyed. After much inquiry and consideration, the committee are satisfied that, notwithstanding the apprehensions and anxiety so generally entertained, a restoration is practicable to a very gratifying extent. The first step must be to procure, for the purpose of being copied and recorded anew, the original patents. In most instances, descriptions and specifications of the inventions, and in perhaps a sixth or eighth part of the cases, drawings also have been annexed to the patents when granted. Drawings have been attached only when referred to in the specifications. The whole number of patents is a little upwards of ten thousand. It is believed that from six to seven thousand may be obtained for record. Many of the deficient drawings may be obtained from patentees, or may be supplied by the assistance of those whose familiar knowledge of the inventions will enable them, aided by the specifications, to delineate them with much accuracy. Many copies heretofore certified from the record to be used as evidence in the courts, will supply others.

Of the models, such as were trifling and unimportant, containing no new principle or combination of mechanism, and not useful for any of the purposes before alluded to, it will not be necessary to replace. The whole number of models was about seven thousand. It is the opinion of the Commissioner, and others most conversant with the subject, that three thousand of the most important can be replaced, which will form a very interesting

and valuable collection, less numerous, indeed, but more select, and scarcely less useful than that which has been destroyed. Some of these would be replaced by voluntary contribution. But the greater portion of them, even of those whose restoration would be most desirable, the committee are satisfied, can only be had by means in the hands of the Government. If it were in the power of the Government to compel the patentees to replace the models and drawings lost by its improvidence, it would be an onerous and unjust tax upon those who, by their ingenuity, and at their own expense, built up an institution which, in its connexion with manufactures, with agriculture, and even commerce itself, has done much to advance the prosperity of the country. They have paid into the Treasury $156,907 73 more than has been required to meet the expenses of the office, including the salaries of the officers employed in it; and the committee cannot hesitate in recommending the appropriation of that balance to carry into effect the provisions of the bill which is herewith submitted.

The sentiment is not an uncommon one, that the tax upon patents is both unwise in policy and unjust in principle. Inventors are public benefactors, contributing to the promotion and improvement of all branches of national industry, and, in most instances, without any adequate remuneration. Who has done more to enrich the South, nay, indirectly, the whole country, than Whitney? And what was his reward? Let the South answer. Evans and Fulton, with genius and talents never, while they lived, appreciated to their worth, died overwhelmed by embarrassments. Whittemore, it is true, was more fortunate; but it was said that he availed himself of the mechanical genius of another who lived and died in poverty and obscurity.

It has not been the policy of our Government to draw a revenue from patentees. The duty imposed was intended only to meet the ordinary expenses of issuing patents. Many believe that even that should not be exacted. It is levying a contribution upon science and ingenuity, which cost the nation nothing, while they confer upon it important benefits.

The measures to be adopted in selecting and obtaining the models and many of the drawings, are matters of detail involving such a variety of circumstances and considerations, that it is impossible to make provision for them by law. That properly belongs, and should be intrusted, to a temporary board of Commissioners. The sum required to replace the three thousand models, which would include all whose preservation would be most desirable, is estimated by the Commissioners at $100,000. The expense of transcribing and recording descriptions, specifications, drawings, and assignments, is estimated at $53,000. A judicious and economical expenditure of these sums, it is believed, will restore the records and models to the full extent contemplated by the provisions of the bill submitted. By the statement from the Treasury Department, (marked E,) it appears that the balance of the patent fund on the 31st December last, was $156,907 73, including moneys received for patents and copies prior to the act of July 1836, which, though not expressly embraced by the terms of that act, properly belong to that fund. This balance will cover the expenditures above proposed of 153,000, together with $3,100 for record-books, desks, and other office furniture, as per estimate D, and leave a balance of $807 73.

With such a restoration, and the addition of the specimens of fabrics and manufactures of various kinds which are in preparation in a number of the manufactories and workshops of the country, to be deposited in rooms in the new building, pursuant to the act of July last, we shall soon have less reason than is now apprehended throughout the country, to deplore the

destruction of this great national repository. In two or three years the number of models will be scarcely less, and their character and value in the aggregate greatly improved.

It appears by the Commissioner that an additional examining clerk, and also another copying clerk are necessary to keep up the increasing business of the office. The new duties assigned to the examining clerk make it a very responsible and laborious office. It is his business to make himself fully acquainted with the principles of the invention for which a patent is sought, and to make a thorough investigation of all that has been before known or invented either in Europe or America, on the particular subject presented for his examination. He must ascertain how far the invention interferes in any of its parts with other previous inventions, or things previously in use. He must point out and describe the extent of such collision and interference, that the applicant may have the benefit of the information in so shaping or restricting his claim of originality as not to trespass upon the rights of others. The applicant should also be referred to the sources of this information, that he may be able to satisfy himself on the particular points of interference. This frequently leads to a lengthy correspondence, before the applicant can be persuaded that his invention, or some rejected part of it, is not new. He often employs skilful and persevering council to urge and enforce by argument new views of the principles of his invention, who sometimes brings to his aid much mechanical astuteness. The examiner must also see that the specification accords with the drawing, and that the model is in conformity with both.

An efficient and just discharge of these duties, it is obvious, requires extensive scientific attainments, and a general knowledge of the arts, manufactures, and the mechanism used in every branch of business in which improvements are sought to be patented, and of the principles embraced in the ten thousand inventions patented in the United States, and of the thirty thousand patented in Europe. He must moreover possess a familiar knowledge of the statute and common law on the subject, and the judicial decisions both in England and our own country, in patent cases. This service is important, as it is often difficult and laborious. Here is the first check upon attempts to palm off old inventions for new, or to interfere with the rights of others previously acquired. This is also the source whence the honest and meritorious inventor may look for aid and direction in so framing his specification as that he may be able to sustain his patent when issued, and find security and protection against expensive and fruitless litigation.

Suitable qualifications for these duties are rare, and cannot be obtained without such compensation as they readily command in other employment. It will, undoubtedly, be wise in the Government to affix such salary to this office as will secure the best talent and qualifications. Although an appeal is allowed by law, yet if a high character is given to it, this will be the best, as it is the most appropriate, tribunal, for judging of these subjects, and its decisions commanding respect and confidence, there will be but little inclination to take exceptions to its judgment. Thus will be cut off a fruitful source of law-suits, and our court calendars will cease to be crowded with cases arising out of the interfering rights of patentees. Meritorious inventors will be secure in their rights, and the public relieved from imposition and embarrassment. These are among the first of the objects and merits of the act of last session. It appears that about one-third of all the specifications are found, on examination, to contain no new principle, and that three-fourths of the residue are either too broad in their

claims of originality, or are otherwise irregular or defective, and are required to be set right at the office or sent back by the Commissioner for correction.

Under existing circumstances, without written, pictorial, or model-record of any kind, it is apparent that the business of the office must either stand still, or proceed under very great embarrassment, which can be relieved only by the early action of Congress on the subject.

A bill is herewith submitted.

A BILL in addition to the act to promote the progress of science and useful arts.

SEC. 1. *Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled*, That any person who may be in possession of, or in any way interested in, any patent for an invention, discovery, or improvement, issued prior to the fifteenth day of December, in the year of our Lord one thousand eight hundred and thirty-six, or in an assignment of any patent or interest therein, executed and recorded prior to the said fifteenth day of December, may, without charge, on presentation or transmission thereof to the Commissioner of Patents, have the same recorded anew in the Patent Office, together with the descriptions, specifications of claim, and drawings annexed or belonging to the same; and it shall be the duty of the Commissioner to cause the same, or any authenticated copy of the original record, specification, or drawing which he may obtain, to be transcribed and copied into books of record, to be kept for that purpose. And wherever a drawing was not originally annexed to the patent and referred to in the specification, any drawing produced as a delineation of the invention being verified by oath in such manner as the commissioner shall require, may be transmitted and copied as aforesaid, together with the certificate of the oath; or such drawings may be made in the office, under the direction of the Commissioner, in conformity with the specification. And it shall be the duty of the Commissioner to take such measures as may be advised and determined by the board of Commissioners provided for in the fourth section of this act, to obtain the patents, specifications, and copies aforesaid, for the purpose of being so transcribed and recorded.

SEC. 2. *And be it further enacted*, That copies of such record and drawings, certified by the Commissioner, or, in his absence, by the chief clerk, shall be *prima facie* evidence of the particulars of the invention and of the patent granted therefor, in any judicial court of the United States, in all cases where copies of the original record, or specification and drawings, would be evidence, without proof of the loss of such originals. And no patent issued prior to the aforesaid fifteenth day of December shall after the first day of June next, be received in evidence in any of the said courts in behalf of the patentee or other person who shall be in possession of the same, unless it shall have been so recorded anew, and a drawing of the invention, if separate from the patent, verified as aforesaid, deposited in the Patent Office; nor shall any written assignment of any such patent, executed and recorded prior to the said fifteenth day of December, be received in evidence in any of the said courts in behalf of the assignee or other person in possession thereof, until it shall have been so recorded anew.

SEC. 3. *And be it further enacted*, That, whenever it shall appear to the Commissioner that any patent was destroyed by the burning of the Patent Office building on the aforesaid fifteenth day of December, it shall be his duty, on application therefor by the patentee or other person interested therein, to issue a new patent for the same invention or discovery, bearing

the date of the original patent, with his certificate thereon that it was made and issued pursuant to the provisions of the third section of this act, and shall enter the same of record: *Provided, however,* That before such patent shall be issued, the applicant therefor shall deposite in the Patent Office a duplicate, as near as may be, of the original model, drawings, and description, with specification of the invention or discovery, verified by oath, as shall be required by the Commissioner. And such patent, and copies of such drawings and descriptions, duly certified, shall be admissible as evidence in any judicial court of the United States, and shall protect the rights of the patentee, his administrators, heirs, and assigns, to the extent only in which they would have been protected by the original patent and specification.

Sec. 4. *And be it further enacted,* That it shall be the duty of the Commissioner to procure a duplicate of such of the models destroyed by fire on the aforesaid fifteenth day of December, as were most valuable and interesting, and whose preservation would be important to the public; and such as would be necessary to facilitate the just discharge of the duties imposed by law on the Commissioner in issuing patents, and to protect the rights of the public and of patentees in patented inventions and improvements. *Provided,* That a duplicate of such models may be obtained at a reasonable expense: *And provided, also,* That the whole amount of expenditure for this purpose shall not exceed the sum of one hundred thousand dollars. And there shall be a temporary board of Commissioners, to be composed of the Commissioner of the Patent Office and two other persons to be appointed by the President, whose duty it shall be to consider and determine upon the best and most judicious mode of obtaining models of suitable construction; and, also, to consider and determine what models may be procured in pursuance of, and in accordance with, the provisions and limitations in this section contained. And said Commissioners may make and establish all such regulations, terms, and conditions, not inconsistent with law, as in their opinion may be proper and necessary to carry the provisions of this section into effect according to its true intent.

Sec. 5. *And be it further enacted,* That whenever a patent shall be returned for correction and re-issue under the thirteenth section of the act to which this is additional, and the patentee shall desire several patents to be issued for distinct and separate parts of the thing patented, he shall first pay, in manner and in addition to the sum provided by that act, the sum of thirty dollars for each additional patent so to be issued: *Provided, however,* That no patent made prior to the aforesaid fifteenth day of December shall be corrected and re-issued, until a duplicate of the model and drawing of the thing as originally invented, verified by oath, as shall be required by the Commissioner, shall be deposited in the Patent Office.

Sec. 6. *And be it further enacted,* That any patent hereafter to be issued may be made and issued to the assignee or assignees of the inventor or discoverer, the assignment thereof being first entered of record, and the application therefor being duly made, and the specification duly sworn to by the inventor. And in all cases hereafter, the applicant for a patent shall be held to furnish duplicate drawings, one of which to be deposited in the office, and the other to be annexed to the patent, and considered a part of the specification.

Sec. 7. *And be it further enacted,* That the Commissioner is hereby authorized and empowered to appoint agents in not exceeding twenty of the principal cities or towns in the United States, as may best accommodate the

different sections of the country, for the purpose of receiving and forwarding to the Patent Office, all such models, specimens of ingredients, and manufactures, as shall be intended to be patented or deposited therein; the transportation of the same to be chargeable to the patent fund.

Sec. 8. *And be it further enacted*, That, instead of one examining clerk, as provided by the second section of the act to which this is additional, there shall be appointed, in manner therein provided, two examining clerks, each to receive an annual salary of dollars; and also an additional copying clerk at an annual salary of dollars. And the Commissioner is also authorized to employ, from time to time, as many temporary clerks as may be necessary to execute the copying and drafting required by the first section of this act, who shall receive not exceeding cents for every page of one hundred words; and for drawings such reasonable compensation as shall be agreed upon or prescribed by the Commissioner.

Sec. 9. *And be it further enacted*, That, whenever the application of any foreigner for a patent shall be rejected and withdrawn for want of novelty in the invention, pursuant to the seventh section of the act to which this is additional, the certificate thereof of the Commissioner shall be a sufficient warrant to the Treasurer to pay back to such applicant two-thirds of the duty he shall have paid into the Treasury on account of such application.

Sec. 10. *And be it further enacted*, That all moneys paid into the Treasury of the United States for patents, and for fees for copies furnished by the Superintendent of the Patent Office, prior to the passage of the act to which this is additional, shall be carried to the credit of the patent fund created by said act; and the moneys constituting said fund shall be, and the same are hereby, appropriated for the payment of the salaries of the officers and clerks provided for by said act, and all other expenses of the Patent Office, including all the expenditures provided for by this act, and also for such other purposes as are or may be hereafter specially provided for by law. And the Commissioner is hereby authorized to draw upon said fund from time to time for such sums as shall be necessary to carry into effect the provisions of this act, governed, however, by the several limitations herein contained. And it shall be his duty to lay before Congress, in the month of January, annually, a detailed statement of the expenditures and payments by him made from said fund.

Specifications of American Patents.

Specification of a Patent for an improved tool, or instrument, for cutting the grooves in the Hubs of Car Wheels. Granted to Francis Barker, Baltimore, Maryland, 1836.

To all whom it may concern be it known, that I, Francis Barker, of the city of Baltimore, in the State of Maryland, have invented an improved tool, instrument, or apparatus, for cutting the grooves in the hubs of wheels for rail road cars, to receive the pins by which they are confined on the axles, and which tool, instrument, or apparatus may also be used in other cases where similar grooves are to be cut in metal for other purposes; and I do hereby declare that the following is a full and exact description thereof.

I prepare an iron mandrel of the size of the bore of the hub, which mandrel I fix so as to stand up vertically from a stout block of wood, or of metal. The mandrel should be of such length as to rise one or two inches above the hub, when the wheel is placed thereon. Along the mandrel I cut

a rectangular, or other formed groove, which may be three-fourths of an inch wide, and as much in depth; this groove is to receive the chisel, by which the cutting is to be effected, and is made the entire length of the mandrel, and down through the block upon which it is fixed, to allow the chisel, and the chips cut by it, to pass clear through.

The chisel I make of cast steel, of such width as to fit, and slide freely down, the groove; and on its outer side or face, it has a semicircular projection, near the lower end, of the size and form of the groove to be cut, and this projecting piece being properly sharpened, constitutes the cutting part of the chisel.

In operating with this apparatus, when a groove is to be cut, the wheel is placed upon the mandrel, the chisel is placed within the groove, into which a loose strip of iron has been introduced to make a bearing for the back of the chisel, and for the purpose of allowing its free return, the chisel being of such a thickness as that the cutting edge thereof will take the proper hold of the hub for the removal of the first chip; it is then driven through by means of a large hammer, or otherwise. A strip of metal of a suitable thickness for a chip, is then placed in the groove of the mandrel to make a bearing for the back of the chisel, which is again driven through, and so on, successively, until the cutting is completed.

Having thus fully described the tool, instrument, or apparatus, invented by me, for cutting grooves in the hubs of car wheels, and for all other purposes to which it may be found applicable, I do hereby declare, that I do not intend by this description to confine myself to the precise form and construction set forth, but to vary the same as I may think proper, so far as may be found necessary to adapt it to the particular purpose to which I may apply it, claiming as my invention, the using of the groove in the mandrel, with the appurtenances above described, as a guide to the chisel, in cutting grooves, the whole operating substantially in the manner set forth.

FRANCIS BARKER.

Specification of a Patent for an improvement in the manufacturing of Cast Iron Sheeves. Granted to Cyrus Alger, Boston, Massachusetts, July 1, 1836.

To all whom it may concern, be it known, that I, Cyrus Alger, of Boston, in the county of Suffolk, and State of Massachusetts, have invented a new and useful mode of manufacturing cast-iron sheeves, for blocks for vessels, and for other purposes where sheeves or pulleys are used, and I do hereby declare that the following is a full and exact description thereof.

I cast these sheeves in the ordinary way of casting such articles, but of a lighter pattern than usual, as, after being cast they are annealed, and rendered malleable. The eye, or hole in the centre, through which the pin is to pass, I make three-eighths of an inch, or more, larger than the pin, for the purpose of bushing it with case hardened iron. The bush I also make of cast-iron, which is to be annealed, turned true, and then case hardened, by the usual process of case hardening, by which means it is rendered perfectly hard upon the surface, whilst it is at the same time so tough as to obviate the danger of breaking from heavy pressure, or sudden jerks. This bush is fixed in its place by means of a set punch.

I tin these sheeves after annealing them, which effectually preserves them from rust, and they may also be coated with japan varnish

I do not claim the making of sheeves, or pulleys, of cast-iron, nor the annealing of such articles, as of my invention; nor indeed any part of the

above described process taken separately; but what I do claim as my invention, or discovery, is the combination of an annealed cast-iron sheeve, with an annealed and case hardened bush of cast-iron, as herein set forth.

CYRUS ALGER.

Specification of a Patent for managing and supplying the fire to Locomotive Steam Engines. Granted to MATTHIAS W. BALDWIN, *Machinist, Philadelphia, October* 15, 1836.

To all whom it may concern, be it known, that I, Matthias W. Baldwin, of the city of Philadelphia, machinist, have invented a new and improved mode of procedure in the art of managing and supplying the fire for the generating of steam in locomotive engines, and I do hereby declare that the following is a full and exact description thereof.

My improvement in the art or method of managing the fire in the furnaces of locomotive engines, consists simply in making the fire in a furnace, fire-place, or grate, which may be detached from, and appended to the boiler at pleasure. The intention of this new mode of managing the fire is to enable me, at each water station, or in any convenient place, to have a clear coal fire waiting the arrival of the engine, so that the grate or fire place which has been in use, may be detached, or slid out, and that containing the clear fire, made to occupy its place. I do not claim to have invented any new mode of constructing the apparatus employed, as methods of effecting this are so obvious that they will at once present themselves to any competent engineer.

The fire whilst burning may be placed under the reservoir from which the tender is to be supplied, thus rendering the heat generated available, giving a supply of hot water from that portion which would otherwise be wasted. The grate containing the fire may be placed on a small car, or on a long lever sunk below the rail road, and so arranged as to transfer it readily.

All that I claim as my invention is the preparing a fire on a grate which may be transferred from the place where it is made, to the proper place under the boiler of a locomotive steam engine, for the generating of steam as hereinbefore set forth.

M. W. BALDWIN.

Specification of a Patent for improvements in a Loom for Weaving Stock Bodies. Granted to CONRAD KILE, *city of Philadelphia, Oct.* 11, 1836.

To all whom it may concern, be it known, that I, Conrad Kile, of the city of Philadelphia, have invented certain new and useful improvements in the Loom for weaving the cloth for stocks, for which loom I obtained letters patent of the United States, dated September 18th, 1835. And I do hereby declare that the following is a full and exact description thereof.

My improvement upon the loom above named consists principally in the means by which I adapt the common straight lathe to the concave breast beam used by me. For this purpose the breast, or straining beam, is cut off, or made straight, on that side which is towards the lathe, and is, also, on that side hollowed out lengthwise, so as to admit the lower rail, or piece, of the frames of the lathe to pass within it, thereby allowing the reed to come into contact, or nearly so, with the breast beam, at every beat thereof. The upper part, and the portion of the fixed breast beam which is towards the workman, over which the yarn, or chain, passes, is hollowed out for the pur-

pose fully set forth and described in my former patent. At every beat, the lathe passes up to the same point, the woven material being received on the cloth beam to an extent equal to that occupied by the bristle, or other filling against which it strikes. On one end of the hollowed cloth beam there is a wheel or pulley, round which a cord passes, having a weight attached to it to operate the cloth beam as it receives the cloth. This wheel, or pulley, is also furnished with a ratchet wheel and pall, to admit of the weight being wound up when necessary, without disturbing the cloth beam. A second ratchet wheel and pall is used at the other end of the cloth beam, to prevent its running back whilst weaving. A wheel, or pulley, similarly constructed, is applied to the yarn beam, by which the proper degree of strain is given thereto, whilst the web is allowed to move forward readily at every beat of the lathe.

The yarn beam may be of any length which may be preferred, taking care to make the concavity in it, and in my cloth beam, such as shall adapt them to the curvature which I wish to give to the woven material. With my improved loom I can use such bobbins, lathe and shuttles, as are in ordinary use, either using them by hand, or operating them by power, as I may see fit. As regards the curvature given to the hollow of the yarn and cloth beams, I now find the girth of the middle of them should be about one-fourth less than that of the ends, the curvature of the breast beam being also adapted thereto.

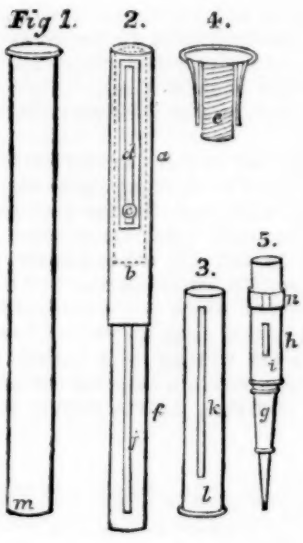
What I claim as my improvement is the manner in which I construct the breast beam, as above described, for the purpose of enabling me to use a straight lathe for weaving stock bodies, such lathe made in the ordinary way: I also claim those changes described, as made in the arrangement of the other parts of the apparatus, to adapt it to carrying out this improvement, the nature of which will be fully understood by comparing this description with that of my former loom, no part of which is intended to be claimed in the present specification. And I further claim the use of a loom constructed upon the principles set forth, to the weaving of a variety of other articles to which a bias is given by having the chain longer in one part than in another, such, for example, as stock stiffeners, jackets, corsets, and parts thereof.

Specification of a Patent for an improved Ever-pointed Pencil and Pen-Case. Granted to Jacob J. Lownds, *city of Philadelphia, Sept.* 22, 1836.

To all whom it may concern, be it known, that I, Jacob J. Lownds, of the city of Philadelphia, have invented a new and improved ever-pointed pencil and pen case, and that the following is a full and exact description thereof, reference being had to the drawing which accompanies, and makes a part of, the specification.

The exterior tube of this case is open at its two ends only, not having any longitudinal slit to admit a slide for protruding the point, this being effected in a different manner, to be presently described. This exterior tube as represented at fig. 1, has a plain surface, but it may be ornamented in any way which may be preferred. Figs. 2 and 3 show the interior tube which fits into fig. 1, within which fig. 2 is made to slide. The upper part of fig. 2, contains the pen-slide and holder, and also the reservoir for spare pencil points; the latter consists of a tube concentric with the tube *a*, and its place is represented by the dotted lines; it reaches down to *b*, where it is soldered to a diaphragm, or partition, reaching across that part of the tube,

and extends up to the upper end of *a*, and is there enclosed by a small screw cap; its length is sufficient to enable it to contain two lengths of pencil points. The pen holder is situated in the space between these two tubes, and this is slid out by means of the small screw button *c*, working in the slot *d*, the tube *a* being reduced, or flattened, to allow the head or button *c*, sufficient space without obstructing the passage into the exterior tube. When the pen is retracted there is sufficient space between the reservoir and the tube *a*, to carry two extra steel pens with perfect convenience. Fig. 4 is the screw cap, or head of the pencil case; *e* is a tube, having a screw cut on the outside of it, the female screw into which it works being cut in the inside of the upper end of *a*, the exterior of which tube passes within the cap, whilst the tube *e* admits the point of the pen; by this arrangement the whole length, nearly of the cap is saved in the length of the pencil case.



The lower end of the interior tube, fig. 2, is that which receives the pencil point and its appurtenances, to be now described. Fig. 5, which contains the lead, is, at the lower part *g*, made, in all respects, like those in general use; its upper, or cylindrical portion, *h*, is to occupy the part *f*, of the tube fig. 2; *i* is a projecting check piece, or feather, which when fig. 5 is in its place, occupies the slot *j*, and also the slot *k* in fig. 3, this latter tube fitting on to *f*, fig. 2, the two slots *j* and *k*, being made to coincide, and the feather *i* rising high enough to pass through both of them: When the respective parts 2, 3, and 5, are put together, the whole is to be passed into the exterior tube fig. 1, the lower end *l* of fig. 3, is then attached to the lower end *m* of fig. 1, by soft soldering them together, and on screwing the head fig. 4, into its place, the instrument is complete.

Operation of the instrument. When the pencil point is within the case, the feather *i* occupies the upper ends of the the slots *j* and *k*; and to cause the point to protrude, the tube fig. 2 is drawn up by means of the head fig. 4; this tube sliding in the exterior tube, and also in fig. 3; the drawing up of the interior tube brings the lower part of the slot *j* into contact with the feather *i*, which consequently checks it; on pushing the head down, the pencil point is protruded, and ready for use; and when no longer wanted it may be readily pushed back by the finger. To cause the cylindrical part *h*, of fig. 5 to slide freely and evenly within its tube *f*, it is surrounded at *n* by a divided spring ferule, which is in part received within a groove turned in *h* for that purpose. When the pen is to be used the tube is to be drawn out, the head unscrewed, and the pen protruded, by means of the button as before described; the head may be screwed into the opposite end, a female screw being cut within *l* for that purpose.

Having thus fully described the ever-pointed pencil and pen case, invented by me, and thereby shown that it differs essentially from others, in the general arrangement and combination of its parts, throughout, with the single excep-

tion of that portion thereof which contains and protrudes the lead point, I do hereby claim this particular arrangement and construction, which I esteem as sufficiently characteristic to distinguish it from all others before used or known. I do not intend, however, by this claim, to limit myself to the manner of constructing this instrument in all its minutiæ, as herein pointed out, but to vary it as I may think proper, whilst it remains substantially the same in construction and operation. JACOB J. LOWNDS.

Progress of Practical and Theoretical Mechanics and Chemistry.

On the absolute value of the most common species of Wood employed as Combustibles. By MESSRS. PETERSON AND SCHOEDLER.

(From the Annalen der Pharmacie, vol. XVII., cahier 2, p. 139.) (Journal de Pharmacie, No. VII., 1836.)

The exact and detailed experiments of Messrs. Gay Lussac and Thenard, have proved that the pure ligneous fibre of wood, that is its skeleton, when completely freed from soluble parts, by means of acids, alkalies, alcohol and water, has the same composition in all species of wood. This result, though possessing interest in a scientific point of view, still affords in practice no basis for calculating the value of the combustible; for what is burned is not mere ligneous fibre, but wood, possessing all the mixtures of ingredients which determine the nature of the tree from which it is derived. But these materials may, like rosin or the oily substances, augment the combustibility; or like some others, they may diminish it. Such were the considerations which induced the authors to undertake the following analysis; and to this long and tedious labour, Messrs. Schoedler and Peterson devoted themselves with uncommon perseverance, in the laboratory, and under the immediate inspection of the illustrious Liébig.

Each species of wood, in the condition in which it comes from the forest, was before combustion with the oxide of copper, reduced to the finest powder, placed in a drying apparatus surrounded with boiling water, and heated in a current of air until the powder lost no more of its weight, then weighed with due care to avoid its attracting any new portion of moisture. The mixture of it with oxide of copper was performed in a hot porcelain mortar, and having been conveyed into the tube where it was to undergo combustion, it was again freed from all hygrometric moisture, by subjecting it to a moderate temperature in an exhausted receiver. The results of the combustion were carbonic acid and water, which served to determine the amount of carbon and hydrogen. All the species of wood left after combustion, a certain quantity, though proportionably very small, of ashes, containing carbonates.

Every analysis, therefore, gives a trifling error in the proportion of the carbon--which, however, never exceeds 2-10 of one per cent.—less than the most common errors of observation, and as we may with sufficient exactness regard the quantities lost, as equal for all the species of wood analysed, the general conclusions derivable from the results are not in the least changed on this account. All the specimens of wood were taken from the trunks of their respective trees.

Species of Wood.	Quantity of the substance burnt.	Carbonic acid.	Water.	Carbon.	Hydrogen.	Oxygen.
1. *Quercus Robur.*	0.353	0.629	0.190	49.270	5.974	44.756
Oak.	0.371	0.665	0.206	49.595	6.163	44.242
	mean	of the	two	49.432	6.069	44.499
2. *Fagus Sylvatica.*	0.360	0.628	0.203	48.235	6.258	45.507
a Red Beach.	0.409	0.712	0.232	48.134	6.296	45.575
			mean	48.184	6.277	45.539
3. *Fagus Sylvatica.*	0.287	0.503	0.164	48.461	6.271	45.268
b White Beach.	0.256	0.450	0.146	48.605	6.330	45.065
			mean	48.533	6.301	45.166
4. *Betula Alba.*	0.316	0.556	0.180	48.652	6.325	45.023
Birch.	0.257	0.446	0.147	48.552	6.424	45.024
			mean	48.602	6.375	45.023
5. *Betula Alnus.*	0.262	0.457	0.145	49.169	6.262	44.569
Alder.	0.232	0.413	0.129	49.223	6.172	44.605
			mean	49.196	6.217	44.587
6. *Pinus Larix.*	0.270	0.492	0.156	50.389	6.413	43.198
Larch.	0.313	0.564	0.175	49.824	6.206	43.970
			mean	50.106	6.310	43.584
7. *Pinus Abies.*	0.256	0.462	0.149	49.901	6.460	43.639
Fir Tree.	0.276	0.499	0.158	49.992	6.354	43.654
			mean	49.946	6.407	43.647
8. *Pinus Picea.*	0.254	0.457	0.146	49.750	6.380	43.870
Pitch Pine.	0.278	0.447	0.100	49.433	6.388	44.179
			mean	49.591	6.384	44.025
	0.261	0.471	0.146	49.898	6.209	43.893
9. *Pinus Sylvestris.*	0.270	0.488	0.153	49.976	6.290	43.734
				49.937	6.250	43.813
10. *Prunus Domestica.*	0.257	0.460	0.135	49.492	5.830	44.678
Plum Tree.	0.233	0.414	0.128	49.130	6.090	44.772
			mean	49.311	5.964	44.725
11. *Prunus Cerasus.*	0.368	0.650	0.208	48.840	6.250	44.910
Cherry Tree.	0.229	0.405	0.130	48.809	6.301	45.890
			mean	48.824	6.276	44.900
12. *Pyrus Malus.*	0.244	0.430	0.139	49.729	6.323	44.948
Apple Tree.	0.302	0.836	0.169	49.075	6.211	44.714
			mean	48.902	6.267	44.831
13. *Pyrus Communis.*	0.278	0.498	0.160	49.533	6.388	44.079
Pear Tree.	0.334	0.595	0.190	49.258	6.314	44.428
			mean	49.395	6.351	44.254
14. *Diospyrus Ebenum.*	0.256	0.460	0.123	49.727	5.333	44.950
Ebony.	0.186	0.336	0.090	49.950	5.370	44.679
			mean	49.838	5.352	44.810
15. *Buxus Sempervirens.*	0.253	0.452	0.147	49.400	6.449	44.151
Box Tree.	0.266	0.471	0.158	49.337	6.593	44.070
			mean	49.368	6.521	44.111
	0.262	0.494	0.149	50.227	6.312	43.461
16. *Ulnus Suberosa.*	0.236	0.428	0.139	50.146	6.537	43.317
			mean	50.186	6.425	43.389
17. *Populus Nigra.*	0.272	0.491	0.152	49.925	6.203	43.972
Poplar.	0.242	0.433	0.440	49.472	6.421	44.105
			mean	49.699	6.312	43.989

Species of Wood.	Quantity of the substance burnt.	Carbonic acid.	Water.	Carbon.	Hydrogen.	Oxygen.
18. *Fraxinus excelsior.* Ash.	0.303	0.538	0.166	49.096	6.081	44.823
	0.214	0.384	0.117	49.616	6.068	44.316
			mean	49.356	6.075	44.569
19. *Juglans Regia.*	0.308	0.545	0.180	48.927	6.487	44.586
	0.281	0.501	0.162	49.299	6.399	44.302
			mean	49.113	6.443	44.444
20. *Robinia Pseudacacia.* Acacia.	0.315	0.552	0.176	48.455	6.201	45.344
	0.366	0.591	0.192	48.883	6.342	44.775
			mean	48.669	6.272	45.059
21. *Tilia Europea.* Linden.	0.247	0.443	0.159	49.592	6.882	43.526
	0.323	0.575	0.199	49.224	6.889	43.937
			mean	49.408	6.861	44.731
22. *Aesculus Hippocastanum.* Horse Chesnut.	0.254	0.451	0.154	49.096	6.729	44.175
	0.310	0.550	0.187	49.058	6.699	45.268
			mean	49.077	6.714	44.209
23. *Salix Fragilis.* Willow.	0.259	0.457	0.150	88.828	6.429	44.743
	0.300	0.530	0.170	48.850	6.290	44.860
			mean	48.839	6.360	44.901
24. *Acer Campestris.* Maple.	0.253	0.455	0.143	49.217	6.273	44.510
	0.290	0.518	0.166	49.390	6.340	44.270
			mean	49.803	6.307	43.890

Species of Wood.	One hundred parts required for complete combustion in oxygen.	Subtraction of the quantity of oxygen already contained in each species of wood.	Quantity of oxygen that 100 parts of each kind of wood must absorb for their complete combustion.
1. *Tilia Europea.* Linden.	184.254	43.731	140.523
2. *Ulmus Suberosa.*	182.797	43.389	139.408
3. *Pinus Abies.*	182.024	43.647	138.082
4. *Pinus Larix.* Larch.	181.666	43.584	138.082
5. *Aesculus Hippocastanum.* Horse Chesnut.	182.211	44.209	138.002
6. *Buxus Sempervirens.* Box Tree.	181.426	44.111	137.395
7. *Acer Campestris.* Maple.	180.850	43.890	136.960
8. *Pinus Sylvestris.*	180.744	43.813	136.981
9. *Pinus Picea.* Pitch Pine.	180.911	44.025	136.886

Species of Wood.	One hundred parts required for their complete combustion in oxygen.	Subtraction of the quantity of oxygen already contained in each species of wood.	Quantity of oxygen that 100 parts of each kind of wood must absorb for their complete combustion.
10. *Populus Nigra.* Poplar.	180.617	43.989	136.628
11. *Pyrus Communis.* Pear Tree.	180.135	44.254	135.881
12. *Juglans Regia.*	180.134	44.444	135.690
13. *Betula Alnus* Alder.	178.540	44.587	133.953
14. *Salix Fragilis.* Willow.	178.752	44.801	133.951
15. *Quercus Robur.* Oak.	177.971	44.499	133.472
16. *Pyrus Malus.* Apple Tree.	178.171	44.831	133.340
17. *Fraxinus Excelsior.* Ash.	177.820	44.569	133.251
18. *Betula Alba.* Birch.	178.252	44.023	133.229
19. *Prunus Cerasus.* Cherry Tree.	178.039	44.900	133.139
20. *Robinia Pseudacacia.* Acacia.	177.602	45.059	132.543
21. *Fagus Sylvatica.* White Beech.	177.478	45.166	132.312
22. *Prunus Domestica.* Plum Tree.	176.813	44.725	132.088
23. *Fagus Sylvatica.* Red Beech.	176.373	45.539	130.824
24. *Diospyros Ebenum.* Ebony.	173.288	44.810	128.478

The first of the above tables requires no explanation. In the second the quantities of oxygen which 100 parts of each species of wood absorbs from the air, in effecting its complete combustion, have been calculated. These represent the relative values of the woods as fuel, since the quantities of heat developed by combustion are proportional to these quantities of oxygen.

It will probably excite, at first, some surprise that the different sorts of wood do not follow the order, which their price or their value in common life seems to assign them.

The proportion of carbon contained by them will be found pretty nearly equal, but the chief difference is in that of the oxygen. When therefore, we consider that 100 parts by weight of hydrogen, require for combustion 800 parts of oxygen, while 100 of carbon demand but 262 of oxygen, it will be easy to understand why the wood of the linden tree, which contains a large portion of hydrogen, should develope more heat by its combustion,

than that of the beech, which contains but a small proportion of the same ingredient.

It follows, likewise, from this view, that the value assigned to the woods in common life, is quite independent of their absolute *combustible value*, and must be determined by other considerations. For the domestic purposes of heating apparatus, as in kitchen fire-places, stoves, &c., a fuel is required which is less remarkable for giving an intense, than a moderate, durable, heat; consequently those species of wood will be preferred which abound least in hydrogen, and have a higher proportion of carbon. The linden, the firs, and the pines, are rich in hydrogen. This it is, chiefly, which, united with a certain proportion of carbon, yields the gas that constitutes the flame of a wood fire. These kinds of wood yield a quick and an intense heat, with a brisk flame, leaving a light and scanty charcoal. On the quantity of hydrogen in wood depends that of the charcoal remaining after combustion, for the hydrogen forms with the carbon, carburetted hydrogen gas, and necessarily takes up *some* of the carbon. With beech, on the contrary, it produces a short flame, proportionally much less vivid, and it is to the remaining coals, which continue to glow for a long time, that so high a value is attached. Oak, both with regard to these properties, and to its actual value, holds a middle rank between these two species of wood.

If we could construct our fire-places according to the exigencies of each kind of wood, the value of each kind for the purposes of life, would be exactly expressed by its place in the second table. But this is not the case. The following example shows how this value is equalized. Throughout the north the chief fuel employed is the wood of fir and pine. In those countries, however, it is not burnt in cast-iron stoves, but in those of clay or masonry, by which the quick and intense heat is absorbed and retained by the stoves, which give it out but slowly. Here then the heating apparatus *is* constructed according to the fuel, and to attain the same end fir and pine will be preferred, weight for weight, to beech wood.

In regard to the quantity of charcoal which the carbonization of each species of wood will yield, it must be inversely proportional to the quantity of its hydrogen; for the more hydrogen there is, the more carbon will it take up in forming carburetted hydrogen gas, and the less carbon will there be left. Results in practice, on a large scale, are entirely in accordance with this view of the subject. What has already been said applies to woods taken in equal weights. But wood is generally bought and sold by measure,* and consequently a difference in price arises from the difference of specific gravity in the different kinds.

According to the experiments of Mr. Bull, in the United States, a cord of dry wood contains in pounds, the following quantities, viz:

		Of Charcoal.
Shell bark hickory,	4469 lbs.	36 bushels.
Chesnut white oak,	3955	36
White oak,	3821	39
Red heart hickory,	3705	32
Shell bark white oak,	3464	32
Red oak,	3254	30
White beech,	3236	33
Black walnut,	3044	31
Yellow poplar,	2516	27

* In France, wood has for several years been sold by *weight*.

Yellow pine,	2463	33
Jersey pine,	2137	26
Pitch pine,	1904	33
White pine,	1868	30

It follows, that under an equal volume of hickory, oak, or beech, there is far more matter capable of generating heat, than in the case of poplar or of any of the pines.

Soft and light wood offers to the oxygen a larger surface, since it burns more readily and perfectly than the harder and more compact varieties. The latter only undergo a process of distillation from the interior parts, and when the included gases have been burnt, there remains a residuum of carbon from nineteen to twenty-five times greater than in the case of the lighter woods.

The experiments of Peclet have demonstrated clearly that the radiant heat of ignited gases, that is of flame, is infinitely weaker than that of red hot coal. Hence it results that the proportion of radiant heat must be very different in burning the different kinds of wood. The harder and more compact any species of wood is, and the less it contains of hydrogen, the greater is the quantity of radiant heat it is capable of producing. The soft woods give the least quantity of radiant heat. We ought then to reject the soft woods containing much hydrogen, from all those processes of heating which particularly require radiant heat. To heat boilers where the radiant heat is to be applied directly to the surface heated, in open fireplaces and stoves, the hard woods are to be preferred. But when the object is to produce a high temperature at a certain distance from the fire, as in stoves and furnaces of masonry, in the manufacture of porcelain and glass, the wood which produces the most charcoal has the least value, for the furnace is choked up with coals, without producing the effect of a flame which extends on every side, and applies directly, by contact, to the surface to be heated.*

Manufacture of Sulphate of Soda. A new process for obtaining this salt has been secured by patent to Richard Phillips, Lecturer on Chemistry at St. Thomas' Hospital, and which he thus describes:

It is well known that when certain kinds of the persulphuret or bisulphuret of iron, commonly called iron pyrites, or martial pyrites, and sometimes merely pyrites, are exposed to the action of the air and of moisture, the sulphur which the pyrites contains is, for the most part, by oxidizement, converted into sulphuric acid, and the iron which the pyrites contains is also, by oxidizement, converted into oxide of iron, and the sulphuric acid and oxide of iron thus formed, combining, they constitute with water a solution of sulphate of iron, copperas, green copperas, or green vitriol, with an excess of sulphuric acid, and the heaps of pyrites which are thus exposed to air and moisture for the purpose of preparing sulphate of iron, or green vitriol, are called copperas, or pyrites, beds. The liquor which is yielded by the action of the air and moisture upon the pyrites of these copperas beds, is an aqueous solution of sulphate of iron or green vitriol, with excess of

* The use of pine and other soft woods is, however, preferable in steam boilers, where a great extent of fire surface is intended to be exposed to the contact of flame. Tr.

See Annales de Chimie et de Phys. for July, 1833, for a valuable paper by M. Berthier, entitled, *Examen de quelques combustibles.*

sulphuric acid, and this liquor I call "the entire liquor," meaning thereby that it contains the whole, or nearly the whole, of the sulphuric acid formed by the action of the air, and of moisture, on the sulphur of the pyrites in the copperas beds, as above described.

The use of this entire liquor (on account of the large quantity of sulphuric acid which it contains) is one of my said improvements in the process of manufacturing sulphate of soda. For this purpose I take sixty parts (by weight) of common salt; frequently called muriate of soda, and sometimes chloride of sodium, and put it into a reverberatory furnace of the usual construction, and I add to it such a quantity of the entire liquor before described as would, if mixed with a sufficient quantity of an aqueous solution of acetate, nitrate, or other convenient salt of lead, give a precipitate of sulphate of lead which would weigh, after proper washing and drying, about one hundred and sixty parts, these one hundred and sixty parts of sulphate of lead, indicating the presence of sulphuric acid equal to about fifty parts, by weight, of concentrated liquid sulphuric acid, or oil of vitrol, and which are required for the decomposition of sixty parts of common salt, so as to convert it into sulphate of soda. I also take the specific gravity of the entire liquor, and on future occasions when its specific gravity is the same, or nearly so, I determine the quantity of it to be used with sixty parts of common salt, by its specific gravity alone, and without repeating the trial as to the quantity of sulphate of lead which is yielded by a given portion of it. And I may here observe that the greater the specific gravity of the liquor, the greater will be the advantage to the manufacturer.

The entire liquor, and common salt, being well mixed in the reverberatory furnace, I heat the mixture, as usually practised in the decomposition of common salt by sulphuric acid, occasionally stirring it, until acid vapours cease to arise from it; the residue of this operation is a mixture of oxide, or peroxide, of iron and sulphate of soda, and usually a small but unimportant quantity of common salt; I heat this residue in water to, or nearly to, its boiling point, in any convenient vessel, and when the water is nearly or sufficiently saturated, I suffer the peroxide of iron to subside, and the clear solution being conveyed to proper vessels, it yields, by cooling, crystals of sulphate of soda.

Having now described what I consider to be the best process for obtaining sulphate of soda by decomposing common salt with the entire liquor, I will proceed to describe another of my said improvements, which consists in the use, when circumstances render it eligible or convenient, of the crystalized sulphate of iron, green copperas, or green vitriol, obtained from the entire liquor (or in any other mode) by the usual processes.

For this purpose I reduce about one hundred and fifty parts, by weight, of the crystallized sulphate of iron, or green vitriol, to powder, and mix it with sixty parts, by weight, of common salt, and I heat the mixture in a reverberatory furnace in the same manner as before described, and I treat the residue in the same way as already described with reference to the residue obtained when the entire liquor is used.

Another of my said improvements consists in the use of the solution remaining after the separation of the crystals of sulphate of iron in the ordinary process of making green vitriol, and which solution is termed the "mother waters;" the strength of this solution, and the quantity of it to be used with a given weight of common salt, I determine by means of the proportion of sulphate of lead which it yields, exactly in the same manner as described with respect to the use of the entire liquor; I also take its specific

gravity for the reason already stated with respect to the entire liquor, and I treat the mixture and residue as already mentioned with regard to those processes previously described. Rep. Pat. Inv.

Means of facilitating the expression of oil from seeds. A patent was taken in March, 1835, by Henry Walker Wood, of London, for applying a diluted acid, (muriatic acid for preference) previously to pressure, whereby the seed, it is alleged, will part more thoroughly with the oil. The following is the method he prescribes—"Take about one hundred pounds of seed, and, during the time that it is being ground, sprinkle it regularly with about three pounds two ounces of muriatic acid, diluted with about six pounds and a quarter of water; this is supposing the acid to be of 1160 specific gravity. By the process of grinding and sprinkling, the diluted acid will be intimately mixed with the ground seed. This mixture of seed, acid and water, is to be permitted to stand for some hours, twelve will be generally found sufficient, though the time will vary, depending on the quality of the seeds, but this will be soon ascertained by practice, and a short time longer or shorter will not materially influence the result of the process. The mixture is next to be submitted to pressure by placing it in bags, and disposing the same in the press, in the following manner; first, a bag of seed, next a plate of iron, then a bag of seed, and so on. I prefer an hydraulic press, and the pressure is to be exerted in the usual manner. By this improvement it will be found that the seed will part with the oil more thoroughly, and a larger quantity of oil will be obtained from a given quantity of seed than heretofore. Having now described the invention, and the manner of performing the same, I would remark, that although I have stated exact quantities of acid and water to be applied to a certain quantity of seed, yet I do not confine myself thereto, as it will be found that the quality of the seed will in some degree vary the quantities of the diluted acid, which will produce the best effect, but this must in a great measure depend on the judgment of the workman, which can only be obtained by practice, but the above quantities are given as average quantities; nor do I confine myself to the use of the particular acid named, or to the applying the diluted acid precisely at that part of the operation called grinding, as the same may be mixed subsequently but before the pressure is applied. Ibid.

Hancock's Steam Carriage. One or two of this gentleman's steam carriages have been travelling without intermission since the 11th of May last. That steam locomotion on common roads is both practicable and safe to the passengers and the public, he has proved; it now remains for him to show (which it will be seen by the following letter, containing a statement of his late performances, he promises shortly to do,) that his travelling has been economical, so as to return a fair profit to any capitalist who may embark his money in a speculation of the kind.

Mr. Hancock is now the only engineer with a steam carriage on any road. Sir Charles Dance, Colonel Maceroni, Dr. Church, Messrs. Ogle, Summers, Squire, Russel, Redmond, Heaton, Maudsley, Frazer, and a host of others—where are they? Echo answers—"Where!" Strange to say, however, we see steam carriage companies advertised, whose engineers

have either never yet built a carriage, or whose carriages when built have never stirred out of the factory yard!

Sir.—Tuesday evening, the 20th inst., completed twenty weeks continued running on the Stratford, Islington, and Paddington roads, during this year, and I beg to hand you as faithful an account as I can of the performances of my carriages.

Since the last notice in your Magazine, a new carriage, the "Automaton," has been brought upon the road, the only difference between which and those preceding it is, that the engines are of greater power (having cylinders of twelve inches diameter, whilst those of the others are of nine inches,) and the carriage altogether of larger dimensions than the others, it having seats for twenty-two, whilst they are only calculated for fourteen passengers. It is an open carriage like the "Infant;" and although only calculated for the accommodation of twenty-two passengers, it has carried thirty at one time, and would then have surplus power to draw an omnibus or other carriage containing eighteen more passengers, without any material diminution of speed; its general rate of travelling is from twelve to fifteen miles per hour. On one occasion it performed (when put upon the top of its speed, and loaded with twenty full grown persons) a mile on the Bow-road, at the rate of twenty-one miles per hour.

The first time the "Automaton" was brought upon the road, (the latter end of July) it conveyed a party to Romford, and back, at the rate of ten to twelve miles per hour, without the least interruption or deviation in its working, although it was the first, or as I may call it, the day of proving, nor has it required any repairs whatever to this time.

After this digression in describing the "Automaton," I will return to the actual work done on the public roads and streets of the metropolis during the last twenty weeks, or five months, in as concise a manner as I can:

The miles run, about - - - -	4,200
Passengers carried, - - -	12,761
Trips—City to Islington and back, - - -	525
Do. do Paddington do. - - -	143
Do. do Stratford do. - - -	44
Supposing the carriage had always been full, the passengers carried would have been - - -	20,420
Average time a carriage has run each day—5 hours 17½ minutes.	

An exact account of the number of times that the carriages have gone through the city in their journeys has not been kept, but I should suppose that it must be more than 200. For the last five weeks a carriage has been at the Bank twice a day, viz. between the hours of 2 and 3 and 5 and 6 in the afternoon.

It was on one of the morning trips from Stratford to the Bank, through the city, that the steamer became entangled with a waggon at Aldgate; and which, I am happy to say, is the only accident worth recording. The shafts of the waggon were swung by the contact, against the projecting front of a shop; the damage done was trifling, and occasioned by the wheels of the steam carriage having got into the iron gutter, and out of which it is not an easy thing to gain the fair surface of the street with any ordinary carriage in so confined a situation as that part of Aldgate in which the accident happened; and it should be observed, that this occurred in making way for another carriage passing at the time.

I will now give you an account of all other accidents (which have all happened to the damage of the steamers themselves,) viz. the chain pulley of the "Enterprize" once broke on the axletree; the same occurred once to the "Infant," which were permanently and immediately replaced by castings from the same pattern, with a greater thickness of metal, and which have since stood well.

The severe test afforded by the state of the City Road and onward to Paddington, caused these failures, for the pulleys had stood well on the other roads, for many miles.

Another accident was a hind-wheel of the "Erin" coming off in the New Street, near the Bank, on which occasion the carriage sunk only about eight or nine inches, in consequence of the frame-work of the machinery taking the ground; and so little was the coach thrown out of the level, that the inside passengers were surprised when informed that the wheel was off. The concluding accident was by the steerage chain of the "Infant" being too slight, and breaking at Islington, when the carriage turning short round, with one of the fore wheels against the curb, the wheel was broken. This wheel was an old one, of much slighter construction than I now make them.

In the early part of the five months' running, the close-bodied carriages, "Erin" and "Enterprize" were about equally employed—in the latter part, and to the present time, in consequence of the fine weather, the open carriages "Infant" and "Automaton" have been running.

I have occasionally examined the boilers and engines of all the carriages, and found that the engines have in most parts actually improved, whilst the boilers and fire-places have suffered a deterioration, less than could have been expected, from the use they have undergone.

It may be remarked, that both boilers and machinery are suspended on well-acting springs, and which accounts for the state of all the parts being so well preserved. Some of the boilers have been in use for two or three years.

There have been consumed in the before mentioned traffic, 55 chaldrons of coke, which is equal to 76 miles per chaldron, or about 2¼*d.* per mile for fuel; but this on long journeys would be much reduced by the application of the moveable fire-place, patented by me about three years ago, as our greatest expenditure of coke in these short journeys is in lowering and again raising the fire.

I cannot conclude without noticing with gratitude, the general civility and attention which I have met with, and my pleasure in discovering that the antipathies which existed in the earlier part of my career are gradually subsiding, and that, in fact, I never now meet with incivility, excepting with a few carters or draymen, who consider the introduction of steam-carriages as an infringement upon the old established use of horse flesh.

Years of practice have now put all doubts of the economy, safety, and superiority of steam travelling on common roads at rest, when compared with horse travelling; and I have now in preparation calculations founded upon actual practice, which when published will prove that steam-locomotion on common roads is not unworthy of the attention of the capitalist, though the reverse has been disseminated rather widely of late by parties who do not desire that this branch of improvement should prosper against the interests of themselves.

After twelve years of incessant labour in steam-locomotion, yours, &c.

WALTER HANCOCK.

Stratford, Sept. 22, 1836.

Lond. Mec. Mag.

Anti Attrition Compound. To one part of lime water (a saturated solution of lime) add one part of olive oil, unite them well by thorough stirring or agitation, and they form a soapy compound of the consistence of cream. If too weak for the purpose, more oil may be added. This compound is said to be better than pure oil for the lubrication of small works.

For cogs or teeth of wheels, whale or common oil may be taken in the proportion of one part to two of lime water. It assumes the consistence of thick paste, when a small quantity of carbonaceous matter, such as plumbago, or soot, may be added and well incorporated.

For this compound a patent was taken out in England, by N. Partridge, in December, 1835. Lon. Jour. Arts and Sciences.

Lubrication by Water. Sir,—I perceive in the report, of the *Times*, of the proceedings of the scientific meeting at Bristol, that Dr. Lardner suggests placing water-pots before the wheels of a train of railway carriages to reduce the friction. The fact of a train running lighter on a wet day is well known to every engine driver; and it occurred to me to avail myself of the water leaking from the boiler, or tender, passing it, in the first instance, into the ash-pan, from which the excess drops in a small jet behind the engine wheels; thus the engine passes over the dry, and the tender and train over the wetted part of the rail. In the event of the boiler being so tight that the leakage would be insufficient, two small tubes, with regulating cocks, should pass from the tender, or cistern, and discharge a small jet on the rails as the train passes along. I shall feel obliged by your insertion of this letter in your earliest Number, in order to advance my title to the priority of this useful adaptation of what would be otherwise lost water.

Yours, &c. W. J. Curtis. Lon. Mec. Mag.

Progress of Civil Engineering.

Traction on Rail-ways.

From an article in the Dublin Review, No. 1, (May, 1836) on "*The Rail Road System in Ireland.*"

A modern Railway may be defined to be a perfect Road—hard, dry, and level, presenting the least possible resistance from irregularities of surface or inclination. Vehicles properly contrived, and furnished with wheels and axles, peculiarly constructed to move along the iron tracks with the least friction; and the untiring mechanical engine, compressed into the smallest useful compass, mounted on a carriage, supplied from a portable boiler, with steam at a high pressure, and yoked in front of the frame to be moved, give forth an irresistible power, transporting passengers and merchandize with a speed and economy wholly unattainable by means of animal resources.

The force necessary to move any given load on a horizontal line, is expressed by writers on mechanics in terms of the load itself. On a Railway extremely well laid, and in good order, with the bearing perimeter of the wheels turned perfectly true; with the best fitted axles, properly lubricated, and the iron rails clean and dry, or quite wet, the friction is reduced to its lowest terms. By friction is to be understood the sum of the obstruction to the movement of the carriage or train of

carriages, arising from the *resistance* to the rolling periphery of the wheels as they move along the rails, and the *friction* at the axles from the insistent load. The amount of *resistance* is small, and, supposing the rails to be clean and in order, need not, by the general enquirer, be distinguished from the sum total of the friction.

Experiment has satisfactorily proved, that the friction is the same at all velocities. To overcome this friction, or, in other words, to overcome the *vis inertiæ* of the load, a certain power is requisite, varying somewhat, as will be presently shewn; but which power, on a Railway, is now usually taken to be about $\frac{1}{250}$th part of the load, whatever that may be. Now a ton consisting of 2240 lbs. the $\frac{1}{250}$th part thereof is 9 lbs. nearly; and it is the ordinary expression in Railway parlance, to call the friction 9 lbs. to the ton. Some engineers prefer taking 10 lbs. to the ton, or $\frac{1}{224}$th part of the load, as the measure of the friction, in all states of the weather, of the Railway and of the carriages. Others consider that 8 lbs. or $\frac{1}{280}$th, or even 7½ lbs, or $\frac{1}{300}$th part of the load, to be a sufficient allowance. The above form the extremes for practical purposes; but experiments have been made on carriages, with axles so constructed, and the Railway in such good order, that the friction, in one case, appeared to be as small as 2¼ lbs. to the ton, or $\frac{1}{1000}$th part of the load; and in some other instances, only 4 or 5 lbs. or $\frac{1}{500}$th of the load. These are, however, only interesting as illustrative of what is possible, under very peculiar circumstances; but like many experiments on models, would lead to false conclusions, and be deceptive, if stated to be true in general practice.

Under all the states of road and weather, then, the exertion of a force (animal or mechanical) of 9 or 10 lbs. will move a ton upon a level Railway. Now an ordinary horse, travelling at the rate of about 2½ miles an hour, and working 10 hours daily, exerts a force of about 128 lbs. This, indeed, is a point rather unsettled among engineers, and a horse-power is usually taken higher; but it is a safe average for all horses. The momentary effort of a powerful London dray horse is perhaps four or five times what is above assumed, while a weak, ill-fed animal, used through a long journey, would be scarcely equal to half the above effect. An ordinary horse can take, however, about 14 tons along a level Railway, at the rate of 2½ miles an hour, working all day; but the power of an animal to draw is diminished as he is driven more rapidly. A horse capable of travelling 12 miles per hour, would only draw 3 tons on a level Railway at that velocity, and could not continue to do so any length of time.

The application of animal power is therefore very limited, and it is to steam recourse has been had, to obtain high velocities. Though it is true that the friction, and of course the power, requisite to move the dead weight, is the same at all velocities, yet the velocity itself is only obtained in the ratio with which the power to overcome the friction of the load is supplied. In a locomotive steam engine, of the best modern construction, the velocity may be defined in a general way, to be regulated by the boiler-power—that is, the capability of the boiler to supply steam, of effectively high pressure, with sufficient rapidity, so as to enable the pistons to make a greater number of strokes per minute, thereby turning the wheels round a greater number of times, and of course urging the machine to a higher speed. So the load which the same engine can draw, supposing it to have sufficient adhesion on the rails,

may be expressed to be regulated by the diameter of the cylinders, the pressure of the steam, and the length of the stroke of the piston, from which elements are obtained a certain expression of value in lbs. called the cylinder-power, which, divided by 8, 9, or 10 lbs. as the friction may be assumed, gives the number of tons which the engine is capable of drawing. This is by no means a scientific, and perhaps not a strictly correct description; but it will convey an approximate idea of the power and effect of the locomotive engine, which is all that is necessary on the present occasion.

The most remarkable circumstance in the application of steam-power on railways, is the mode in which the steam, having done its duty in the cylinders of the engine, is discharged up the chimney, and entering therein under a pressure still considerably higher than the atmospheric pressure, produces a momentary vacuum; this is followed by a rush of air from the flues or tubes of the boiler, thus creating a great draught from the furnace, and, by drawing the heated air in the increased velocity through the tubes, generates steam in the boiler with proportionate rapidity. This steam supplies the force to overcome the friction of the load with corresponding velocity, and is again quickly discharged from the cylinders into the chimney to produce the preceding effect in the increased speed. The absolute power of a locomotive engine is therefore measured by the velocity with which the engine moves; and a machine which at 15 miles an hour may be called a twenty-horse engine, at 30 miles an hour becomes a forty-horse engine. Many singular and important consequences hence present themselves to the engineer; it would lead us too far astray from our general subject to attempt to analyze them; but the practical result is, to add to the other reasons for keeping railway lines as nearly horizontal as attainable, since the velocity, and consequently the power of the engine, is greatly diminished when ascending acclivities, from several causes, particularly from the effects of gravity, upon which we shall proceed to remark.

The power necessary to overcome the friction that is to move a load, is stated in terms of the load; and so is the power requisite to overcome the effects of gravity, when the line deviates from the horizontal. The rise of any such plane is usually expressed by the proportion between the base and perpendicular of the right-angled triangle, of which the inclined plane forms the hypothenuse, being an inch, a foot, a yard, &c. vertical, to so many inches, feet, yards, &c. horizontal. Thus, a plane which rises one foot, or any other lineal measure, in 250 feet, or any other number of lineal measures, is said to rise 1 in 250; and the expression of the power requisite to overcome the effects of gravity is $\frac{1}{250}$, being that fraction or proportion of the load; and if the load be one ton, then the power to overcome the gravity due to a rise of 1 in 250, is nearly 9lbs. The power requisite on a rise of 1 in 224, is 10 lbs. per ton; and the power on a rise of 1 in 280, is 8 lbs.; and on a rise of 1 in 300, about $5\frac{1}{4}$ lbs.; and so, by dividing the number of pounds in a ton (2240) by the number which expresses the proportion of the base to the perpendicular, of any triangle such as above, being the denominator of the fraction a table may be formed exhibiting the power per ton, requisite to overcome the power of gravity on all inclinations, to be added to the friction on ascending planes; and (to a certain extent only however) to be deducted from the friction on decending planes.

In describing the gradients of a rail-way, it is usual to state the rise

per mile in feet, as well as the proportion of the rise or perpendicular lift to the length or base. In order to illustrate more clearly the great increase of power required when inclinations occur, we have thrown into a tabular form the force or power required to overcome the friction which is a constant quantity at all velocities and at all slopes, and the force to overcome the gravity, which varies as the line of the angle of inclination.

Force or power per ton.	LEVEL.	5¼ Ft. per Mile. $\frac{1}{1000}$	7 Ft. per Mile. $\frac{1}{754}$	12 Ft. per Mile. $\frac{1}{440}$	16 Ft. per Mile. $\frac{1}{330}$	21 Ft. per Mile. $\frac{1}{250}$	50 Ft. per Mile. $\frac{1}{106}$	66 Ft. per Mile. $\frac{1}{80}$	106 Ft. per Mile. $\frac{1}{50}$
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Friction,	9	9	9	9	9	9	9	9	9
Gravity,	0	2.2	3	5.1	6.8	9	21	28	45
Total,	9	11.2	12	14.1	15.8	18	30	37	54

If the friction be taken at 7½ or 8lbs. per ton, or at 10lbs. per ton, the substitution of these numbers would respectively decrease or increase the above totals.*

The importance of keeping railways as nearly level as possible is self-evident from this table. With the medium friction, so small a rise as 1 in 1000 requires 25 per cent. additional power; with a rise of 21 feet per mile, the power must be doubled; and on an elevation of 1 in 80, which would be scarcely heeded by the traveller on a road, the power must be fully quadrupled. It may be mentioned here, incidentally, that this inclination of 1 in 80 is considered the practical limit for locomotive engines to work upon; and when imperative circumstances compel the adoption of such a slope, it should be for a very short distance.

The average friction on most of our present turnpike roads being assumed at 56lbs. to the ton, the power is not doubled until the rise becomes 1 in 40; while on a railway whose friction is 9lbs. to the ton, the power is doubled when the rise is 1 in 250. It is therefore a mere corollary to observe, that the more perfect the railway, the more injurious are inclined planes.

In descending inclined planes the effect of gravity is in favour of the load, and is to be deducted instead of being added to the friction; but the useful effect of gravity, in this respect, on a descent, does not extend beyond the amount of the friction; and the advantage cannot be said to apply to planes exceeding those on which the gravity just balances the friction, and whereon, if no further power were applied, the load would

* The general result of M'Neil's experiments for measuring the force of traction, or the labour of horses in drawing carriages on different sorts of roads, is as follows:

On a gravel road,	147 lbs.
On a broken stone surface on an old flint road,	65
On a broken stone surface upon a rough pavement foundation,	46
On a broken stone surface upon a bottoming of concrete formed of Parker's cement and gravel,	46
On an excellent smooth, well-laid pavement,	33

The road being horizontal.

And upon a road recently covered with a thick layer of broken stones the traction was found as much as 240 lbs. The absolute amount of *friction* only, of ordinary carriages, is probably not more than 25 lbs.; all above that is *resistance*, more or less, according to the state of the road and weather, and the size and form of the felloes of the wheels.

remain at rest. The angle of inclination on which the friction is exactly equivalent to the gravity, has been hence sometimes called the angle of repose.

When the gravity due to the inclination of the plane exceeds the friction, the load will be impelled downwards with a velocity proportionate to the angle of descent.

Within the last twelvemonth a novel doctrine has been broached, founded on some of the preceding premises, on which it is necessary to say a very few words. It has been stated, that on two railroads, each one hundred miles in length, the one being perfectly horizontal throughout the whole distance, and the other rising for half the distance, at the rate of 1 in 250, and falling at the same rate for the other half, however such inclinations may be distributed over the line, these two railroads may be worked by the same mechanical power.

Nothing can be more absurd or deceptive than to entertain such a fallacy;—like some other mere abstract mechanical propositions, it is totally false in practice. More especially is it to be deprecated as applicable to railways worked by locomotive steam-engines, which machines are not constructed (at least at present) to convert their high speed into additional power, with a slower motion, while ascending inclined planes; for, as has been already observed, their power depends upon the maintenance of their velocity, and it is upon inclined planes the engines lose their speed, and consequently their power, at the very time it is most wanted, and particularly, as in the case in question, on planes of 1 in 250, when their power is required to be doubled. What might be true theoretically, in this case can never be obtained practically. The theory supposes, that at any moment the additional power requisite, being the double of that required on a level line, can be supplied and given out on the ascent; and that on the descent the whole of the power is saved and economised. A number of practical difficulties at once arise—such as the slipping of the wheels in unfavourable weather, the diminution of the positive amount of adhesion at all times, the additional wear and tear of the engines, strained to the utmost exertion of their power, and the extra injury done to the railroad on the inclines, which is even greater on the descent than on the ascent. A moment's reflection will shew that on the descent, the steam, although not given out at the moment, must necessarily be kept up in the boiler, to be ready for the next piece of level road, or for a start after a stopping, &c., and that in the meantime it is blowing off at the safety valve. In order to keep up the *velocity*, which is the great element in railway traveling, the load throughout the line, undulating 1 in 250, must be only one half of what could be carried on the level,—or a second engine must be ready to help on the ascents, while the first engine must necessarily continue with the train while descending, and nothing is saved in practice but a small quantity of fuel. And if the rise of 1 in 250 were continued in one slope of 50 miles, the equally continuous descent on the other side, though presenting an apparent economy of power, would require a third engine to help the return cargo upwards, or the second engine must travel downwards after the train, to be ready to assist the returning load. So that in *practice* a double set of engines must be employed, although in *theory* the actual mechanical power is the same upon a level line and on a line rising and falling at the rate of 1 in 250.

The preceding theory having gained ground from the respectable au-

thorities who have promulgated it in more than one High Court of Judicature, and in publications of a scientific character, it has become a duty to point out its fallacies, and to bring the public to distinguish between the abstract amount of mere mechanical force, and the positive necessity of keeping up the means of supplying additional power when wanted, without the possibility of any real economy, when the actual giving out of power is not required.

Another material element in the consideration of locomotive power, is the load which an engine can draw after it, not as calculated from the cylinder power of the machine, but from its own weight insistent upon the rails. This has been called the adhesive power of the engine. The amount of this adhesion was long unknown to engineers; and the early history of locomotive engines shews that various contrivances were made and patents taken out, to effect a greater amount of adhesion than was supposed to exist. It is now well ascertained, that the amount of adhesion, that is, the capability of an engine to drag a load after it on a railway, is determined greatly by the state of the weather. The adhesion of one iron bar sliding on another, is usually estimated at one-seventh of the weight of the bar moved. In a locomotive engine, the adhesion is ordinarily allowed to be one-fifteenth of its weight; though, under favourable circumstances, it is often as much as one-twelfth, or even one-tenth, while it is sometimes so small as a twentieth, or even a fortieth. The adhesion is also diminished in proportion to the rise of the plane.

As experience has been gained in the practical working of railways, it has been found advisable on many accounts, among which to acquire adhesion is not the least, that the locomotive engines should be made much heavier than originally constructed. Three, four, five, and six tons constituted the original limits, which have been successively extended. An ordinary locomotive engine for level lines, is now never made of less weight than ten tons. As the railways deviate from the horizontal, a heavier engine to transport a proper load at a high speed, becomes necessary; and engines of twelve tons weight may henceforth be considered as likely to become in general use. We shall, therefore, explain the amount of adhesion of such an engine.

The adhesion, that is, the grip, bite, or hold, which the wheels of a locomotive engine have upon the rail, has already been stated to be on an average the one-fifteenth part of the weight of the engine. But the whole weight of the engine is only applicable to overcome the loads when the wheels are coupled together; and this is not usually the case, except for assistant engines on inclined planes, and for engines moving at a comparatively slow rate. In those locomotives adapted for high velocities, the fore and hind wheels are not coupled, and it is only the weight insistent on the driving wheels, that is, the wheels directly acted upon from the cylinders by the connecting rods, which affords the adhesion. In a twelve ton engine, the weight on the driving wheel is about two-thirds of the whole weight, say eight tons; and it is one-fifteenth part of this weight, or, in round numbers, about 1200lbs., which, under the average circumstances of weather, and the state of the rails, is the adhesive power of such an engine,—this being divided by the friction, viz. 9lb. to the ton, gives about 133 tons as the load which can be drawn on a horizontal railway, without the wheels slipping. The ratio of diminution of adhesion is as the sine of the angle of inclination. On frosty mornings, when the atmosphere is humid, and the rails covered

with rime, there is scarcely any adhesion, particularly on inclines, and the engines are unable to get on, the wheels turn round without advancing, and the steam copiously supplied at the moment of the first check, is soon blown off, and, however great the cylinder power, the train is totally stopped. If the wheels of a twelve ton engine are coupled, the whole weight will be available in the computation of the adhesive power, and the load would be 200 tons.

It will be supposed, that a certain proportion becomes requisite in the construction of a locomotive engine, between the power of adhesion and the cylinder power, which it is only necessary to allude to here, as we have already unconsciously entered into a longer preparatory description than first intended, having, indeed, scarcely left ourselves the opportunity of adding a few paragraphs on railway curves.

The leading distinction in the construction of the wheels of carriages adapted for moving on railways, and the wheels of road vehicles, is, that the former are fastened to the axletree, which revolves with them, turning in friction boxes of a peculiar kind; whereas, in ordinary carriages, the axle remains fast, and the wheels revolve thereon: Experience has taught this to be absolutely necessary for railway wheels, especially at high velocities. In order to retain the wheels upon the raised rail, or iron track, whereon they roll, the tire is furnished with a projection called the flanch; now universally placed on the inner side of the wheel, and about three quarters of an inch deep.

In laying out lines of railway, curves should be avoided as much as possible; but when this cannot be effected altogether, recourse must be had to means of obviating the effect of the centrifugal force, and of the additional friction of the flanch of the wheel upon the rail, otherwise arising from the circumstance of the wheel being fast upon the axle. The former is counteracted by simply elevating the outer rail or convex side of the railway track according to a simple formula well known to engineers: the radius of the curves taken to the centre of gravity of the load, and the maximum velocity of the train forming the principal elements therein, in connexion with the breadth of the track: the latter is remedied by allowing some little additional play in the gauge of the wheels, beyond what would be necessary if there were no curves. What is called the *cone* of the wheel is not applied on account of the curves, but to throw the flanch of the wheel from coming into contact with the button or edge of the rail generally, throughout any portion of the road. The perimeter, or bearing surface, or tread, of the wheel, being in fact the frustrum of a cone, and the difference of the diameter on the side of the wheel where the flanch is placed, and on the other side, that is, between its whole breadth of about four inches, is about one-eighth of an inch. And it is best, if practicable, to lay the rails so that their surfaces be not perfectly horizontal, but parallel to the inclination or cone on the wheels, the tread being thereby uniform upon the broad top of the rail, and not partial, as is too often the case, breaking down the projecting button or upper web of the rail.

The exactness with which railway curves are laid out, and the perfect manner in which they become tangential to each other and to the straight parts of the road, form one of the principal cares of the engineer; simple practical rules exist for this purpose, but they are not often attended to.

The increased loads and velocities on railways, requiring engines of

greater power and weight, has made it necessary to increase the strength of the iron bars very materially. The rails on the Stockton and Darlington line were at first only 28 lbs. to the yard; on the Liverpool and Manchester railway they were 35 lbs. to the yard. On the Dublin and Kingstown road they were 45 lbs. to the yard; and most of the recent railways are constructed with rails of 60 lbs. to the yard, and even 75 lbs. has been tried; but in these last two cases, the bearings or distances between the points of support have been increased from 3 feet to 4 and 5 feet respectively.

It would lead into too long and too detailed a paper to attempt here to enter into any discussion as to the mode of laying down a railway, after the necessary excavations and embankments are made, and the bridges and other constructions built to restore the existing communications by land and water, so as to isolate the railway as effectually as if it were a river or canal; but we may mention, in general terms, that the more perfect and effectual the system of drainage, the more efficiently will the road be kept in order, and too much attention cannot be bestowed on this point. It may also be mentioned as the opinion of several engineers of much practical experience, that all the previous attempts to make a non-elastic railway have been productive of unprofitable results. A railway laid on massive blocks of stone, and secured as completely as art can effect, certainly presents the least resistance to the mere motion of the load; but the successive passage of heavy trains of carriages, at great velocities, and impelled by powerful locomotive engines, soon dislocates the best laid railway; and as it is a continual contest between the impinging force and the resisting road, a positive amount of wear and tear arises to the engines and carriages, of a much greater extent than may be supposed. The resistance of the non-elastic blocks causes a disorganization of the moving machinery, and thence arises the double destruction of the railway and of the trains moving upon it.

It appears also, that the motion of a train of carriages, when passing over the portions of a railway laid on wood, is much easier to the passengers, and causes less jar on the road, and to the machinery and vehicles; and although a certain positive additional amount of steam power may be required when the railway is somewhat elastic, this is much more than compensated by the saving in the wear and tear.

In pursuance of this idea, experiments have been made, by which it appears that beams or baulks of timber laid longitudinally, and connected occasionally by transverse pieces, to keep the road in gauge, are most likely to be much used for railways, the iron rails being fastened thereon. At the present high price of iron, and in places even where stone is not dear, this mode will be found very economical. The bars may be rolled in a particular form; so as to avoid the necessity of using chairs or pedestals to support the rail, which would be laid lengthwise on the wood beams, and having thus a continued support, the bar itself may be made lighter. Rails of 36 to 40 lbs. per yard, would be sufficiently heavy, thus affixed. Such railways would require a much smaller expense to keep them in repair, and the softness of the movement thereon, as experience has shewn, would greatly diminish the destruction of carriages, now occasioned by the continual jars on a non-elastic road.

On Civil and Mining Engineering. By T. Sopwith, C.E., F.G.S.

The universities of this kingdom and numerous public schools afford ample opportunities of acquiring general knowledge, but there is not throughout the whole of this great commercial and manufacturing country any establishments which are expressly adapted to that kind of knowledge in which the vital strength of this and every other nation really consists.

With every feeling of respect for classical literature, not only as an ornamental, but as a firm and enduring basis of human knowledge, it is our conviction that it occupies a greater share of time and attention in the routine of education generally, than it is entitled to in a country where practical skill and an intimate acquaintance with art and science are so much required of by far the larger class of society. The establishment of academies for this latter description of learning is yet a desideratum, and it is one which we trust the increasing knowledge and activity of the present age will speedily accomplish.

It is true that in latter years the universities have been more and more enlightened by the progress of their members in various sciences, and it is also true that schools generally are greatly improved by the introduction of studies of a general nature; for many pursuits, opportunities are thus afforded of acquiring as large a share of general information as is requisite, but there are other departments of business to which the knowledge thus obtained is not so applicable. The education of the nobility, gentry, and clergy, usually terminates with the studies prescribed for them in the colleges or schools they attend; but with men of business the school and college are to be followed by another kind of education to fit them for the respective professions or business for which they are destined. In the usual routine of commercial and manufacturing establishments, the experience of a few years, accompanied with ordinary application, is all that is requisite. In the medical profession a still further course of study is required, and it is only by passing a rigid examination that the medical student is authorised to practice. In following the profession of an engineer, and especially that of a mining engineer, the proficiency of the student is not subjected to any test, and his eventual success is in most instances the only criterion of merit. In this and in every profession it will be found that success, generally speaking, is the lot of all who diligently pursue their avocations, and so long as we live in a land of freedom it would perhaps be impolitic to place any restrictions on the exercise of professional duties, other than as the common interest of society demands, as is the case in medical and surgical education. We shall now proceed to show in what manner we conceive that a public establishment might be advantageously formed for the advancement of persons intended for the professions to which we have more particularly alluded.

The duties of civil and mining engineers are of great importance to the community. Independent of the immense capital frequently placed under their direction, the lives and safety of the public often depend on the skill and security of their works. In mines this is particularly the case, and the numerous accidents which from time to time occur in mines is a strong reason for the advocacy of every improvement that can be readily obtained. When a student has gone through a good course of education at school, followed by a clerkship in the office of an

engineer, the universities are now the only places in which he can seek for any further accessions of knowledge. The expense, the peculiar forms, and the inadequacy of the instruction for practical purposes, at these institutions, are such as to preclude many young men from any attempt to avail themselves of the privileges they afford, nor is there any other establishment at present existing in which the student of these professions can improve himself by a regular course of study. Such an establishment, we conceive, ought to be formed in London, founded on the principle, and conducted in the manner, of the Royal College of Surgeons. The objects of this establishment would be as follows:—To institute a regular course of studies in chemistry, mineralogy, and geology, in particular, and in mechanics, hydrostatics, and other departments of physical science generally, with especial reference to the works undertaken by engineers, and to the duties to be performed by the conductors of mines. Geometry and the drawing of plans and sections would form an especial object of such an establishment, and by its instrumentality many important advantages might be conferred on the mining interests. As branches of such a college, establishments ought to be formed in the principal mining districts throughout the kingdom, where, under a general system founded on and supported by the parent institution, the humble classes of mine agents might obtain such knowledge as would be useful to them in their several departments. As regards miners,—*the mine* itself is the great school in which most is to be learnt; but, in addition to the matter-of-fact details to be learnt underground, there can be little doubt that much solid advantage would flow from a more general diffusion of scientific knowledge among the practical managers of mines.

An intimate acquaintance with scientific details, opportunities of studying mineralogy, with access to the collections in the British Museum and Geological Society—attendance on regular courses of lectures, and the pursuance of a methodical train of studies under the discipline of a collegiate institution, together with the stimulus of acquiring some distinctive marks of proficiency, would, we doubt not, tend materially to advance civil and mining engineering. From the influential members of the Geological Society and of the Institution of Civil Engineers, very able and efficient aid might be probably obtained in the formation of such an institution, and in recommending it to the notice of government. The subject is one which has for some time past received much attention from those who are interested in the progress of mining and engineering; and the important feature which railway projects now form in the commercial statistics of this kingdom, is a convincing proof of the necessity of cultivating, as much as possible, those useful and practical details which can only be afforded by an institution expressly adapted to these objects. Such an institution, we trust, will ere long be actively promoted; and, if once established, we firmly believe that it would tend to increase the talent and respectability of the profession of engineering—would add value to public undertakings, by the skill bestowed on their construction—that it would disseminate that *eminence* in reputation which is now engrossed by a few individuals, who are overloaded with work—in short, that it would give character and stability to a department of knowledge, which, as compared with classical learning, has been greatly underrated and neglected, but which is, nevertheless, of the greatest

importance to the best and most permanent interests of this country and of mankind. London Mining Review.

Captain S. Brown's Metallic Light-houses.

It has been proposed to place a light-house on the Wolf's Rock, near Land's End, a position where it would be exposed to the most violent storms of the Atlantic, and a plan was drawn up for the purpose by Mr. Stevenson, who holds a high rank in this department of engineering; which plan, Mr. Brown thinks, would require fifteen years for its execution, and cost 15,000,000*l.* Mr. Brown undertakes to erect one of bronze, ninety feet high, which would answer the purpose as well as the stone one of 134 feet; for 15,000*l.*, and to complete it in four months. Light-houses are generally of masonry, the outer stones clamped with iron, and in large blocks to lessen the number of joints. The one on the Eddystone Rock, near Plymouth, erected by the celebrated Smeaton, is 24 feet in diameter at the base, and 90 feet in height, of which 72 consists of solid masonry. That built by Mr. Stevenson on the Bell Rock, near Arbroath, is 40 feet in diameter at the base, and 110 feet in height, of which 102 consists of solid masonry. The defects of such a structure are obvious. In the first place, it consists of some thousand pieces; and, among as many thousand joints in it, a few faulty ones would be fatal to its strength. Secondly, its great breadth presents an enormous surface to the action of the winds and waves.

Mr. Brown's proposed metallic light-house is 90 feet high, 14 feet in diameter at the bottom, and 4 feet at the thinnest part. The lower half, called the base, is in four pieces, each piece consisting of a portion of a hollow cone (or paraboloid,) wider below than above, and about 10 feet high; the lower piece is sunk 3 feet into the rock, and is 14 feet in diameter at its under margin; the fourth piece is six feet in diameter at top. These four pieces fit into each other, the neck of the lower passing into the socket of the upper, and both being secured by flanches; so that the joints are, in some degree, stronger than the entire part of the shaft. Above these is the smaller part of the shaft, which is in three pieces of nearly the same length, and fitted in the same manner. Above this the shaft widens out into an inverted cone, which forms one piece, and supports the more important parts. These are, first, the keeper's house, which is 8 feet in diameter, and 7 feet high, with a gallery round it, "for look-out, and walking exercise." Next the lantern 9 feet wide and 10 feet high to the cupola, for containing the lights. The house, or sitting room, is made of two concentric cylinders of sheet copper, 9 inches asunder, to equalize the temperature, and attached to each other by rivets: it is formed into compartments for bookcases, shelves, and lockers, with a recess for the back of the stove. Immediately below the house, in the swell of the shaft, are the sleeping berths. To complete the description of the column, we shall add, that the upper section of the base contains two tanks, one for oil, and one for fresh water, the next section, above, is for coals and provisions; and the one above that a general store. Access is obtained from below by the chain ladder reaching down to the sea; and by ladders in the inside, by which the keepers mount to their aerial abode. The whole work, 90 feet high, would cost 16,000*l.* or 17,000*l.*, if entirely of bronze; 11,300*l.* if the base were bronze, and the upper part cast-iron; or 9000*l.* if entirely of cast-iron; and it would be erected in four months.

The advantages of this plan of Mr. Brown are the following—1. The

expense of erecting light-houses is much diminished, so that six may be erected for the sum now spent on one. 2. The time necessary for building them is contracted from years to months; and the chances of loss of life in the progress of the work are proportionably diminished. 3. The bronze light-house, from the slenderness of its shaft, and the smallness of the resisting surface, will not carry the wave and spray half so high as the stone light house; and, with two-thirds of the elevation, it will afford equal protection to the keepers and the lights. 4. From this slenderness, and its diminished height, the strain of the surge and winds upon it, in a storm, will not exceed one-tenth of what a stone structure is exposed to. 5. It has but eight joints from the bottom to the lantern; while the stone light-house has thousands; and the bronze joints admit of being made as strong as the entire part of the shaft. 6. That its separate portions, being complete circles, cast solid, each is, *per se*, capable of resisting any lateral impulse of the water whatsoever, and the column can only be injured by a transverse pressure operating upon its length. 7. That the cohesion of the materials, or the power of the column to resist fracture by a transverse strain, is probably a hundred times as great as in an equal column of stone. 8. That the natural stability of a bronze column, derived from downward pressure, must be considerably greater than that of stone. In addition to this source of strength, the column is to he secured 10 feet into the rock by numerous bolts; so that it cannot be removed, without carrying all that body of rock along with it, which would require a pressure of several hundred tons.

As to the durability of bronze in water, when proper precautions are adopted, two letters are given from Mr. Brande and Mr. Faraday, which remove every reasonable doubt. Both of them think that cast-iron might answer sufficiently well for the upper part of the column. Nothing is said about the chance of injury from lightning; but the tower, being entirely metallic, it would act, we suppose, as a very perfect conductor, and convey the electricity to the earth without injury to the keepers. Bronze is an alloy of copper and tin. We should have observed that, in Mr. Brown's opinion, a bronze column could be erected on a sand-bank, by piling, or by a different process, which he describes, and where a stone structure would be impracticable.

Lond. Mech. Mag.

Stability of the Menai Suspension Bridge.

The gale on the 23d ult. in the Menai Strait, was probably the most violent that has happened since the Suspension Bridge was thrown across it. An intelligent eye-witness of the effect of the wind, has enabled us to state, that the wind, which was from the S. W.,* seemed to descend upon the bridge; and though it produced no lateral motion, it excited an undulation in the long line which is suspended between the supporting pyramids, to such an extraordinary degree that the wave ran from end to end of the roadway, and measured vertically not less than sixteen feet, that is to say, that its crest was in one part elevated eight feet above an horizontal line, and its hollow depressed, at another part, in the same instant of time, eight feet below it. The highest and lowest points of the wave, occurred at about half way between the pyramids and the centre of the span. The undulation was steady and uniform, but the swell across the roadway was not so, and this

* The direction of the central line of the bridge is nearly N. W. and S. E., so that the wind acted nearly at right angles upon the Carnarvon side.

threw it out of level, one side being the highest at one moment, and the other side at another. This irregularity disturbed some of the planking, and broke a few of the vertical suspender-rods, and some of the small braces which connect the suspending cables; but the saddles on the top of the pyramids, which connect the centre suspending cables with those which run to either shore, were not in the least degree disturbed. As the wind lulled, the undulation subsided, and carriages, &c., immediately crossed as usual. The whole cost of the damage incurred during this severe gale, which lasted twelve hours, will not amount to more than 20*s.* or 30*s.*! To estimate in some degree, the power of the master mind that designed and directed the execution of a work, which could thus endure harmless such an outpouring of this destructive agent, it should be recollected that the height of these obelisks above the sea, low-water, is 173 feet, that they are 552 feet asunder, that the weight that swings between them is, at least, 650 tons, suspended at a height of 121 feet above low water. Its stability after a storm, which produced such remarkable effects, would have been matter of high exultation to its engineer if he had been living. We think that on the monument which is in progress to be raised to his memory, or in the medals which he left as premiums by his will for the promotion of science, now in the hands of an eminent artist, some memorandum of this triumphant struggle might be recorded. We cannot forbear saying more, and asking—Why should not engraving be employed monumentally? In the case of a similar work of genius, we think that the happy representation of the Eddystone Light-house, after a gale from the S. W., has contributed more to the extension of Smeaton's fame, and the preservation of his memory, than adding twenty blocks to the great marble quarry which already exists in Westminster Abbey. We should be deeply interested to see the genius of English sculpture reject the worn-out common-places, and connect the name of Telford with the Menai Bridge, in a composition worthy of their high reputation. Is Roubiliac to be forever a solitary instance of the pre-eminence of common-sense? And is the statue of Newton and his prism to be for ever unique in conception?

Mag. Pop. Science.

Resistance to motion in Canals, in relation to velocity.

Mr. Russell, of Edinburgh, was called upon to lay before the Section the result of certain experiments made by him on the traction of boats in canals at different velocities. On the general principle of the resistance of fluids to bodies moving in them, was grounded the conclusion that it would be an impracticable thing to move the cumbrous boats upon canals at any but very low velocities, except by an expenditure of power so great that the ordinary methods of conveyance by roads would be cheaper. It was believed, that the resisttance would increase with the velocity, by a law so rapid in its variation, that for two miles an hour speed, there would be four times the resistance of one mile; for three miles, nine times that of one mile; for four, sixteen times; and so on, as the squares of the velocities. Here, there was an obstacle to rapid communication by canals, which appeared insuperable. Mr. Russell has shown that there is practically a circumstance which so completely modifies the application of this principle, that when over a certain point of speed is attained, the resistance, instead of increasing when the speed is yet further increased, in point of fact diminishes. In one of his experiments, he found, for instance, that the resistance to the traction of a canal boat, estimated by a dynamometer, increased with the velocity

of its motion nearly according to the law of the squares, up to 7¼ miles per hour, being then 330lb.; the speed being then increased to 8¼ miles per hour, instead of further increasing, the resistance *fell* to 210lb. The speed was yet further increased, and it increased again the resistance to 236lb.; yet, less, be it observed, than at 7¼ miles; 12 miles an hour brought it to 352lb., scarcely more than the resistance of 7¼ miles speed. These results, confirmed by a number of others, had manifestly a practical application, and they have been applied to the working of fast canal boats in Scotland. Mr. Russell has devoted himself to the explanation of them. He states, that where the water of a canal is disturbed by any cause, as, for instance, the admission of a rush of water momentarily into one extremity of it, or the impeding of a body moving in it, there is generated a certain wave, whose motion along the canal is altogether independent of the nature or velocity of the impulse given to it, and dependent only upon the depth of the canal; its velocity being precisely that which a stone would acquire in falling down one half the depth of the canal. With this velocity, the wave moves uniformly and steadily to the very end of its motion, moving slower (if the depth of the canal remain unchanged,) but only diminishes its dimensions, until it disappears, and this not for a very considerable space. He stated, that he had himself followed waves a mile and a half; and that they had been traced unbroken for three miles from the spot where they originated.

The velocity of the wave depending on the depth of the canal, it is manifest, that each canal, differing in depth from another, will have a different velocity of wave, and that each part of the canal differing from another, will alter the velocity of its wave, and thus the waves near the shore will move slower than near the centre of the canal, if the side be shallower than the middle. How, then, have these facts their application to the phenomen observed? Thus, in the experiment described above, the velocity of the wave, ascertained by numerous experiments, was eight miles an hour. As long then, as the boat moved at three, four, five, six, or seven miles an hour, it remained in the rear of the wave; the wave had no effect on it, as the law of the velocities was the theoretical law. At eight miles an hour the boat was, in point of fact, on the wave, and it might, indeed, be seen about the centre of the boat lifting it out of the water and diminishing the traction upon it.

British Association.

Railway Tunnels.

The evidence of several of the most distinguished physicians of London—particularly Sir Anthony Carlisle, M. D., Dr. James Johnson, Dr. Anthony Todd Thompson, and John Prossert, Surgeon—has been taken before a committee in relation to the effects of traveling in a rail-way car through a long tunnel, upon persons in infirm health. They all testify in strong terms against the safety of such passages, especially for those whose lungs are in the least affected, who are troubled with inflamed eyes, or other analagous diseases. The sudden reduction of temperature, and the powerful current of air which is necessarily encountered in these passages, would subject to the hazard of a catarrh, those who are liable to take cold, and in all probability aggravate existing diseases.

They would object to their patients proceeding to Brighton by such a passage. Several of them had experienced danger of this nature in passing through tunnels of six or nine hundred yards. Dr. Johnson in describing the impressions, said—"The deafening peal of thunder, the sudden immersion in gloom, and the clash of reverberated sounds in a confined space,

combined to produce a momentary shudder or idea of destruction, a thrill of annihilation," &c.

Cross-examined by Mr. Wood.

Will you be so kind as to tell me when it was you anticipated annihilation?

Answer.—I did not anticipate annihilation—it was a figurative expression, of course.

Abstract Lond. Mech. Mag.

Premiums for Architectural Plans for the new Houses of Parliament. A premium of £1500 has been obtained by Charles Barry, Esq., and three others of £500 each, to Robert Hamilton, of Glasgow, J. C. Buchler and J. Raitton, of London. There were ninety-three unsuccessful competitors for the premium. Much dissatisfaction appears to have prevailed, both in and out of Parliament, at the manner in which the commissioners formed their decision in awarding the premiums.

At a meeting of the "*Institute of British Architects*," Feb. 15, a letter was read from Mr. Vandaley, a member of the French Institute, by which it appeared that a competition among the architects of Paris, similar, except in the amount of the prizes, to that which has just taken place in England respecting the new Houses of Parliament, has lately occurred in France. The occasion was a monument to be erected to the memory of the distinguished General Foy, for which purpose a million of francs was subscribed in a remarkably short period. The way in which a decision was made is as follows. The drawings and models were first publicly exhibited for a week, and criticisms were eagerly sought from the public journals; the names of the candidates, meanwhile, being sedulously concealed. A commission was then appointed, consisting of architects, painters, &c., members of the Academy; afterwards a second of artists, not members of the Academy; and, ultimately, a selection was made from military men, high in esteem. These last, however, honourably declining to vote upon a subject they had not studied, the choice was left to the first two bodies; who, having the public opinion to assist their judgment, speedily came to a decision, with which nearly every body appears satisfied. One advantage of this plan is, to neutralize the effect of competing architects showing their designs, before sending them in, to numerous friends, which, though all perfectly fair, yet, as these friends may sometimes be among the judges themselves, or have friends among the judges, enables the judges to recognize the plans of individuals, and, of course, to incur the hazard of being more or less prejudiced. In short, all competition whatever ought to be made in public; and the criticisms of the public journals, and of every one capable of forming an opinion, ought to be courted. Even when a church, a workhouse, an almshouse, or any public building whatever, is to be erected, this ought to be the case; and the present seems to be a very suitable time for architects to make an impression on the public in this matter, and to destroy for ever that system of privacy and favouritism, which has hitherto prevailed in this country, to the great discouragement of all men who depended for advancement in the world on merit alone.

Architect. Mag.

Dr. Reid's System of Ventilation.

At the conclusion of a meeting of the Philosophical Society of Edinburgh, the members adjourned to a new apartment, constructed by Dr. Reid, illustrative of his arrangements by ventilation, &c. It is thirty-

two feet long, and eighteen broad; the floor being pierced with fifty thousand apertures for the admission of air. A series of experiments have since been commenced in it, in one of which, intended to show the working of the flues, 100 individuals remained in it for upwards of an hour, the room having been alternately filled with warm and cold air, and partially charged with ether and nitrous oxide, at different times. The air was completely renewed by a slow and insensible current every five minutes, and the various changes so gradually induced, that it was impossible to tell when they commenced. The plan is equally applicable to public buildings and private dwelling houses, as well as to hospitals, churches, public assemblies, and all those places where, from a crowded apartment, the air becomes oppressive, both from heat and noxious effluvia. Lond. Mech. Mag.

Progress of Physical Science.

Performance of Steam Engines in Cornwall.

Mr. Enys made a communication 'On the duty of Steam Engines in Cornwall,' in which were stated some facts connected with the recent history of these engines, which are of the highest interest and importance. There are instances in which the work done by an engine has, by means of certain precautions with regard to the radiation of heat from the boiler, and a method of working the steam, as it is termed, *expansively*, been doubled, with the same expense of coals.

It appears that when the engine of Mr. Watt was introduced into Cornwall, and that of Newcomen superseded, the patentee fixed, as the remuneration for the use of his patent, that he should receive one-third of the profit which his engines would yield over one of the old construction, estimated by the value of the coals which would be saved by it in producing a given effect. The effect was to be estimated by the quantity of cubic feet of water which a bushel of coals would raise one foot high in one hour, called the duty of the engine. With engines of the old construction, this was fixed at about seven millions, and an instrument being contrived by Mr. Watt for registering this duty on his engines, it was found to amount in 1793, to nineteen millions and a half; thus effecting a clear saving of considerably more than one half the coals required to produce the same effect; the profit thus accruing was immense: in one instance, that of the Chacewater mine in Cornwall, Mr. Watt's third of this profit was compounded for at the rent of 2400*l.* annually. In 1778 the duty of Mr. Watt's engine had fallen, from some cause unexplained, to seventeen millions and a half; and after the expiration of his patent, less attention appears to have been paid to the duty of engines than before, when they were registered for the payment of the patentee, and the duty had fallen, in 1812, to thirteen millions and a half. It has now been raised on an average, in the Cornish engines, to seventy millions; being an economy of fuel amounting to between four-fifths and five-sixths of the whole consumption in 1812. The means by which this wonderful economy of fuel has been produced, have been, 1st. A more careful application of all the heat given off by the coals to the production of steam. 2ndly. A more effective application of the steam itself, when thus produced, to the working of the engine. The first object is attained partly by casing the boiler with wood, a space being left between it and the boiler, in which saw-dust is rammed—the case, thus filled, is an admirable non-conductor of heat—a vessel, in which all the heat contained in the boiler is carefully preserved and employed in gener-

ating steam; so effectual indeed is this precaution, that in the engine house, which used to be unbearably hot, the men have been known to require a fire to keep themselves warm. Another method of applying the heat more entirely to the generation of steam, consists in an improved construction of the boiler, by which the heated air is brought in contact with a greater surface of water—or rather of metal, having water on its other surface; and last, but not least, by a more careful cleansing of the interior surface of the boiler from the hard deposit which forms upon it, and was formerly allowed to accumulate sometimes to the thickness of half an inch. These are the methods by which the heat yielded by the coals has been more effectually applied to the production of steam.

The second and great improvement consists however in the more effective application of the steam after its production to the working of the engine, by working it expansively. The meaning of the term "working expansively" is this; the valve through which the steam is admitted would, if there were no expansive power in the steam, manifestly require to be kept open during the whole time that the piston, which it drives before it, was traversing the cylinder, and the instant it was shut off, the piston would cease to move. Steam, however, is an elastic fluid, and the steam at any time admitted into the cylinder would, even if all communication with the reservoir from which it came were closed, still by its own expansive force tend to move the piston, and would actually move it if the resistance upon it were not in excess. Now the improvement of working expansively consists precisely in this expedient of shutting off the steam from its communication with the boiler before the course of the piston is completed, and leaving it to be impelled through the remainder by the expansive energy of the steam already admitted. Formerly the steam continued to be admitted until the course of the piston was completed; now it is shut off when the piston has traversed from one-sixth to one-half the whole length of the cylinder, and thence principally has resulted this enormous saving of fuel.

An engine of Mr. Austin's, at the Consolidated Mine, was, by these means, got up (as an experiment) to a duty of 120 millions, thus producing with the same quantity of coals, nearly nine times the usual effect of the engines commonly in use in 1812. In carrying these various precautions for the economy of fuel into effect, the agents are, of course, the engine men, called stokers; and in inducing them to enter upon them with that good will which could alone bring about the results which we have stated, the exciting cause has been the publication of Duty Papers, copied from registers made, we believe, daily, of the duty of each engine; these are taken with scrupulous accuracy, and with the most certain precautions against deception, and thus a comparison may continually be drawn between the working of different engines, involving the character of the engineers, and even regulating their wages, for a certain allowance is commonly made by the masters for all duty done beyond a certain limit. The engineer is thus induced carefully to examine every part of his engine to keep it in the best possible condition, to husband his coals most scrupulously, and to cherish the heat in his boiler by every conceivable expedient of sawdust and flannel, and wood, and plaster. When the expedient of a sawdust coating was first introduced, it is said that all the sawdust to be obtained in the country was for the time exhausted.

Mr. Enys further mentioned an important improvement in the working of the engines used for stamping the ore in Cornwall. These were formerly double stroke engines, and the rapid motion of the piston was reduced to

that required for stamping, by the intervention of a train of cog wheels. It was believed that the operation of stamping could not be carried on by a single stroke engine, of which class, of course, are all those used in Cornwall for raising water. Mr. Austin,* however, conceived that it would be possible, by the use of large fly-wheels, and heavy connecting rods, to throw enough of momentum into the machinery to carry it through the descending stroke, and effect all the purposes required of it for stamping, and moreover to obtain a great increase of duty by the substitution of a single for a double action engine. He constructed one at Wheal Kitty, from which he obtained the enormous duty (for a stamping engine) of fifty-five millions, instead of a duty which ranged on the old construction from six and a half to twenty-three millions. A part of this effect is however to be attributed to his having dispensed with the train of wheels before used for reducing the velocity, and their friction, and to his having connected the stampers immediately with the crank (as we understood) of the engine. Mr. Enys concluded by proposing a new form of the Cornish duty paper, including the passive resistance or friction of the engine. The following are its principal elements:—

The Efficiency—Gross power, force, and space of steam cut off.
Power—Nett power (independent of friction) available for impelling machinery.
Effect—Gross work done, including friction.
Duty—Real work done.

We consider this communication of Mr. Enys to have been among the most interesting and important made to the meeting. Brit. Assoc. Athenæum.

Instrument for raising Sea Water, &c., from great depths. Dr. Daubeny gave an account of an instrument which he had constructed for taking up water from any required depth in the ocean, for the purpose of chemical analysis, being an improvement of a French instrument contrived for that purpose, and sent out in the *Bonite*. It has been discovered, that the constitution of the air with which rain water and river water are saturated, is not that of atmospheric air: its constituent elements are indeed those of the atmosphere, but they are mingled in different proportions: the atmosphere, every where and under all circumstances, is found to contain 21 per cent. of oxygen; the air, or rather gas, contained by rain and river water, appears by the experiments of MM. Humboldt and Gay-Lussac to contain from 29 to 32 per cent. of oxygen; and sea water, taken from the Mediterranean at a depth of 1000 metres, appears from an experiment of M. Biot to contain 28 per cent. Moreover, it appears, that near the surface the quantity of this air combined with rain and river water, is about one thirty-sixth of the volume. Now, a question arises—is it combined in the same proportion with the water at greater depth? and is its constitution the same? These are questions of great importance, because enormous quantities of air are thus, no doubt, combined with the fluid elements of the earth's surface; and this air must originally have modified, and may now, modify the condition of the atmosphere itself. It is only by taking up water from different depths of the ocean, preserving the air which it contains, that this question can be solved: and for this purpose Dr. Daubeny's instrument was contrived. It was a cylinder of glass, having at one end a valve opening

* We believe this to be the name of the engineer mentioned by Mr. Enys.

inwards, and open at the other end. Within the cylinder was a solid heavy piston, fitting accurately to its interior surface, but moving freely in it. To either end of the instrument, when it was used, a string was to be attached, the opposite ends of this string being fastened, one at the bow and the other at the stern of the vessel. The instrument was to be let down into the water by that string, which was fastened to the open extremity. The heavy piston then being at the bottom of the cylinder, and the upper portion of it being open, and, of course, filled with water, would continue to be so filled until the instrument had sunk to a depth equal to the length of the other string, its further descent would then be arrested, and, by the action of the other string, its position would be inverted. In this inverted position the heavy piston would be at the top of the tube, and descending by its weight would expel the water beneath it, through the open extremity, whilst the space above it was filled through the valve. Time having been allowed for this process, the instrument was to be raised by the string which originally let it down, and it would manifestly return charged with water from a depth equal to that of the string which inverted it. Ibid.

Interference of Gases with each other. Dr. Charles Henry read an essay on what he denominated *gaseous interference.* It is universally known to chemists that if oxygen and hydrogen be mixed, and brought into contact with metallic platinum in the state of wire or foil, or more especially in the spongy form, the combination of these gases is very rapidly achieved, and, if mixed in the proper proportion, they are converted, usually with the phenomena of ignition, altogether into water. It is also well known, and was first noticed by Dr. Turner, that if into an atmosphere of oxygen and hydrogen, mixed in the ratio necessary for forming water, certain other inflammable gases, such as carbonic oxide and olefiant gas be introduced, the combination of the oxygen and hydrogen is, if not altogether suspended, at least materially interrupted. The cause of this remarkable effect has, at different times, attracted the attention of eminent chemists. Dr. Turner has ascribed it to the soiling of the platinum by the interfering gas; Dr. Faraday to some peculiar condition induced in the metal; while Dr. Henry himself, at a period long prior to the present, conceived it to arise from the fact of carbonic oxide and olefiant gas, having a stronger affinity than hydrogen for oxygen gas. In his present paper, Dr. Henry investigated the entire question. The prominent facts and inferences appeared to be that carbonic oxide retards and limits, but does not altogether prevent the action of platinum on the usual explosive mixture, and the same may be said of olefiant gas. The *interfering* power, however, of the former is vastly greater than that of the latter, their ratio being represented by the numbers 18 and 1. In the case of carbonic oxide, carbonic acid is always produced, the amount depending on the form of the platinum employed, the quantity of the interfering gas, the temperature at which the experiment is conducted; and, as a general rule, it may be laid down, that the interfering influence of the gas bears an inverse relation to the energy with which the platinum acts, and the degree of heat—conditions, however, which may be considered as identical. The diminution, and even disappearance of interference at high temperatures, Dr. Henry attributes to a relative augmentation of the affinity of hydrogen for oxygen, an hypothesis indeed established by other and independent facts.

That Dr. Henry's theory of gaseous interference is the true one, he in-

fers from the general fact of no gases exercising any such influence but those which have an affinity for oxygen; and that it is strictly true, at least in the case of carbonic oxide, there can be no question, seeing that some of the oxygen is actually employed in the production of carbonic acid.—Dr. Turner expressed his conviction of the value of Dr. Henry's paper, of the ability with which it was drawn up, and of the correctness of the solution of the problem of interference, and such appeared to be the prevailing opinion.—In the course of the paper several other interesting facts of a collateral description, were stated, and, amongst others, that platinum causes, though slowly, the combination of a mixture of oxygen and carbonic oxide, but that the process is facilitated by the introduction into the jar of a little caustic potash. This latter circumstance he attributed to the removal of the carbonic acid by the potash as fast as it was produced. Ibid.

New Magnetimeter.—The Rev. Mr. Scoresby (*olim* Captain Scoresby) gave an account of two very delicate magnetic instruments. The first of these, he called a magnetimeter, from its extreme delicacy in detecting and measuring extremely minute magnetic influences. The principle of this instrument was that the bar, or other body, in which the minute magnetic influence was to be sought for, was placed on a brass stand, which was capable of being raised or lowered, upon a joint, in such a manner as to place it exactly in the place of the terrestial magnetic equator, in which position the magnetism of the earth exercised no disturbing or inductive effect upon the magnetism of the body under trial. The test was the deviation caused upon a very small but delicate needle, placed upon the brass stand, upon which the brass joint before described turns. So very delicate is this instrument, that, by it, Mr. Scoresby showed that the magnetism produced in a very soft piece of iron, by swiftly drawing it once or twice through his fingers, instantly deflected the needle, and thus became sensible. He also stated, that so delicate was the instrument, that the inductive influence of the small needle upon the bar of soft iron, became quite perceptible, so as to require the equatorial plane to be set at an angle inclined two or three degrees to the magnetic equator, before the position of the influence of the earth and little magnet conjointly, could be obtained. This instrument, he stated, was capable of many useful practical applications; among others, by it can readily be determined the relative softness and goodness of different specimens of iron, for the softer and finer any mass of iron is, the more readily is its magnetism developed; but the more speedily it again loses all appearance of magnetic excitement.

The second instrument was a very powerful, and yet very light, magnet, mounted in such a manner as to be eminently fitted for observing accurately the variation of the needle, as well as its diurnal and annual changes. He stated, that he found a very fatal error prevalent upon the subject of magnets, namely, that the best temper to give to a needle was hard at each end and soft in the centre. So difficult was it to drive the workmen from this, that he had even found one of the needles, furnished him at the commencement of one of his voyages to the Arctic Regions, by the late Captain Kater, and made under the inspection of that great and accurate philosopher, to become useless after some time, in consequence of this very defect. So important did he (Mr. Scoresby) consider this matter, that he had chosen the material for constructing his magnet upon the principle of the extremely uniform temper given to it. This material was the steel busks used for

ladies' boddices. Those most esteemed by the ladies were the most slender and elastic ones, whereas the thicker, and therefore less expensive busks, he found to be best. He preferred those which were about 1-20th or 1-25th, of an inch, and which were well and evenly tempered throughout. Six of these busks, on each side, were then put together by brass pins, in such a manner that they could with great ease be taken asunder when that was required; these bars were kept asunder in the centre by a light piece of wood, in which was placed the agate cup for the centre motion, and in other places thin card paper was interposed, to prevent their touching—this he considered a precaution of some consequence, as otherwise inequalities in the component magnets would materially weaken the compound of all the arrangement described. Upon each end of this magnet was mounted a silver vernier, corresponding to silver graduated arches in the box, placed at the distance of one-half the length of the magnet from the central pin on each side. To relieve the centre of much of the weight of this instrument, a brass gibbet was attached to the middle of the oblong box in which the magnet was placed, and from the centre of this an untwisted fibre of silk descended through the glass cover of the box to the centre of the magnet to which it was attached, and a tempering screw adjusted its length in such a way as to relieve the steel point of almost the entire weight of the magnet. So powerful was this magnet, that a key, held within three inches of it, became so powerfully magnetized by induction, that it supported at its end a ring, such as is used for connecting keys into a bunch. Mr. Scoresby said its delicacy could not be surpassed; and by it very minute changes of terrestial magnetism could be detected, as, the diurnal change, and effect of interposed rocks; and Prof. Christie, who had seen some of its indications before he came from the adjoining room, had even stated his conviction of the probability, that by this the magnetic effect of the solar rays, and the change caused by the passing of a cloud, would become perceptible. Ibid.

Disengagement of Light during the Chemical combination of Metals. By M. Vogel, of Munich. Electro-negative metals, which form with oxygen peculiar oxides, like arsenic and antimony, are very prone to combine in definite proportions with electro-positive metals, whose oxides constitute saline bases.

These combinations of positive with negative metals, are distinguished in various ways from simple alloys, but principally in their not separating when melted and kept long together in a state of fusion. The heavier does not go to the bottom, nor the lighter to the surface. We know on the other hand, that in an alloy of gold, silver and copper, in quiet fusion together, the gold is found in greater quantity at the bottom than at the top of the crucible; in like manner in bell metal, the tin separates in part from the copper.

Zinc and tellurium combine with a considerable disengagement of caloric. In making brass, the melted copper and zinc, at the moment of their union, are apt to spring out, (jetés en dehors) but whether light is disengaged or not, we cannot tell, because the melted mass is itself at a red heat.

The analogy which exists between arsenic and phosphorus is generally known; but arsenic in its relation to the metals, acts like sulphur: at least, with respect to the electro-negative metals, it conducts exactly like sulphur itself, as the following experiment proves.

In a covered earthen crucible I melted two atoms of zinc (64.2) and withdrew the crucible from the fire, and then I added an atom of metallic arsenic (37.6) in fine powder, but previously heated to the point of boiling water. In stirring the mixture with a porcelain rod, the mass—which before was far from being luminous—became incandescent and of a deep cherry red, just as when sulphur unites with different metals; and at this time a small quantity of arsenic inflamed on the surface, and burnt with a bluish light.

It is possible that lead and tin with arsenic, in large quantities, would produce ignition. I did not succeed in producing it, nor by adding antimony to zinc, lead, or tin.

When hydrochloric acid is poured on a compound of arsenic and zinc, of equal proportions, arsenical hydrogen gas is disengaged, and is entirely absorbed by a solution of sulphate of copper.

When this gas is exposed in a flask to the sun's light, dark laminæ, more or less brilliant, cover the interior of the flask. In a dark place only a few spots appeared at the end of a week.

The sun's rays then have the same decomposing action on this gas as heat, for M. Souheiran has shown that the gas heated by a spirit lamp, deposits arsenic, increases its volume one half, and becomes pure hydrogen. We have then an analogy between arseniuretted hydrogen gas and phosphuretted hydrogen gas; for the latter exposed to the sun deposits much red phosphorus, and loses its property of spontaneous inflammation. Jour. de Pharmacie.

On the boiling points of saturated solutions of various Salts. By M. Legrand. The following table indicates the number of degrees of the centigrade thermometer which the several solutions require above that of boiling water, when pure.

Salts.	Prop. of Salt to 100 of water at the point of saturation.	Degrees above pure boiling water.
Chlorate of Potash,	61.5—	4°.2 cent.
Chloride of Barium,	60.1—	4.4
Carbonate of Soda,	48.5—	4.6
Chloride of Potassium,	59.4—	8.3
Chloride of Sodium,	41.2—	8.4
Hydrochlorate of Ammonia,	88.9—	14.2
Tartrate of Potash (neutral,)	296.2—	14.6
Nitrate of Potash,	335.1—	15.9
Chloride of Strontium,	117.5—	17.8
Nitrate of Soda,	224.8—	21.0
Carbonate of Potash,	205.0—	35.0
Nitrate of Lime,	362.2—	51.0
Chloride of Calcium,	325.0—	79.5

A solution may be supersaturated, notwithstanding the commotion of boiling, and attain a temperature more and more elevated, but as soon as the salt subsides, the thermometer goes down again to the point at which it remains during the whole of the evaporation. The liquor is then simply saturated.

Some salts, even in small proportions, prevent the jumping (soubresuats) of liquids during ebullition; others, on the contrary, and particularly carbonate of potash, promote it in a high degree. Various metallic filings prevent these jumpings or bouncings, but all do not possess the property in

an equal degree. The most oxidable, as iron or zinc, are the most efficaceous. They are not changed during the operation. Annales de Chimie.

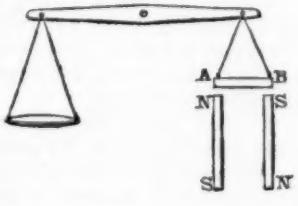
A New Acid, formed of Nitrogen, Sulphur, and Oxygen. By J. Pelouze

M. Pelouze discovered this acid by exposing a mixture of two volumes of the deutoxide of nitrogen, and one volume of sulphurous acid, to the action of a solution of caustic potash in a graduated tube. The mixed gases were entirely absorbed in a few hours, unless there was an excess of either beyond these proportions. The two gases react upon each other only in the proportion of two to one in volume. The new acid thus formed, is called by M. Pelouze, the nitro-sulphuric acid. It unites with the alcalis, and forms salts which are nitrosulphates. The acid consists of two atoms of nitrogen, one of sulphur, and four of oxygen.

The nitro sulphate of potash is a white salt, very soluble in water, insoluble in alcohol, slightly bitter, neutral, crystalizing in irregular hexagonal prisms. It is decomposed at 130 cent. and gives rise to deutoxide of nitrogen and sulphate of potash. It is an anhydrous salt formed of one atom of potash, and one of nitro sulphuric acid. The formula is KAZ^2SO^4. That a distinct acid from the sulphur exists in these salts, M. Pelouze considered to be proved by the fact that they are not precipitated by barytic water. He has not, however, been able to obtain the acid in a separate state. Ibid.

Horse Shoe and Bar Magnets. The following experiments by Professor Ritchie, of the London University, point out the superiority of horse shoe magnets, properly constructed, over an equal extent of bar magnets, when equally magnetized.

Experiment 1. Take two bars of soft steel of any convenient size, cut one of them in the middle, and bend the other into the form of a horse-shoe magnet; temper both to the same colour, magnetize them *equally*, and try their powers in the following manner: bring the two bars, as in the figure, to different distances from the lifter A B, and ascertain their attractive power; remove the bars and substitute the horse-shoe, and its power of attraction, and consequently its *inducing* power, will be found to be much superior. Place the bars and horse-shoe in succession at the same distance from a revolving lifter, and the electricity induced on the coil will be found to be much greater, both in deflecting a needle and in decomposing water, with the horse-shoe magnet, than with the equal bars.



Hence the absurdity of using *bar* magnets instead of horse-shoe ones to *induce* magnetism on soft iron, and thence voltaic electricity on a coil.

Experiment 2. Cut a bar of the same length as before into *three* portions, bend one of the pieces into an arc, magnetize the two parts, apply the arc to form a horse-shoe magnet as Mr. Mullins proposes, repeat the previous experiment, and the *old* horse-shoe magnet will be found to be much stronger than the *new* one.

Horse-shoe magnets, made by ignorant makers, are often left almost en-

tirely *soft* at the bending, and only hardened towards the poles or ends, from the old absurd notion that the magnetism was *accumulated* at the poles. The soft part of the circuit therefore, possessing scarcely any *coercive* power, is very much in the same state with a piece of soft iron.

Lond. & Ed. Phil. Mag.

Combustion at a low Temperature. By M. Williams. When a candle is extinguished in a dark place, so that no part of the wick remains ignited, it continues to shed for a few moments a faint light. If a piece of hot iron, not luminous, be rubbed with a bit of wax or tallow, we perceive in a dark room, a white pale light. These and other similar phenomena were attributed, by Wedgewood, to phosphorescence. I have ascertained that they are occasioned by an imperfect combustion, as they never take place in a vacuum. Different bodies undergo this kind of combustion at different temperatures.

Fresh filings of zinc, iron, cobalt, antimony, copper, &c., shed a feeble pale blue light, when projected on iron heated below redness. Iron heated red hot diffuses, before it becomes obscure, a full white light for a few moments.

Annales des Mines.

Mechanics' Register.

Extent of loss of Property and Lives at Sea. By the report of the select committee of the British Parliament on shipwrecks, presented on Monday, August 15, it appears that the number of ships and vessels belonging to the United Kingdom which were wrecked or lost in the periods specified below, appears, by a return made to the committee from the books at Lloyd's, to be as follows:—

Number of vessels stranded or wrecked—1816, 343; 1817, 362; 1818, 409; total, 1,114.—1833, 595; 1834, 454; 1835, 524; total, 1,573.

Number of vessels missing or lost—1816, 19; 1817, 40; 1818, 30; total, 89.—1833, 56; 1834, 43; 1835, 30; total, 129.

Making a total of 1.203 ships or vessels wrecked and missing in the first period of three years, and a total of 1,702 wrecked and missing in the second period of three years.

2. That, taking the number of vessels wrecked and lost in the two periods named above, at the assumed value of £5000 for each ship and cargo, on the average of the whole, the loss of property occasioned by these wrecks would amount in the first three years, to £6,015,000, being an average of £2,005,000 per annum; and in the last three years to £8,510,000, being an average of £2,836,666 per annum.

3. That the number of ships in each of the years above specified of which the entire crews were drowned, though the exact number of each crew is not stated, appears, by the same return made to your committee, from the books at Lloyd's, to have been as follows:—

Number of vessels in each year, of which the entire crews were drowned—1816, 15; 1817, 19; 1818, 15; total, 49.—1833, 38; 1834, 24; 1835, 19; total, 81.

Making a total of 49 in the first period of three years, and a total of 81 in the second period of three years.

4. That the number of persons drowned in each of the years specified, in addition to the above, and of which the number drowned belonging to

each vessel is distinctly known, appears, by the same return from Lloyd's books, to be as follows:—

Number of persons drowned in each year by ships named—1816, 945; 1817, 499; 1818, 256; total, 1,700.—1833, 572; 1834, 578; 1835, 564; total, 1,714.

5. That, assuming the average number of persons in each of the vessels of which the entire crews were lost, to consist of ten individuals, including officers, seamen, and passengers, it would appear, that in the first three years the number of persons drowned were 490 in the forty-nine vessels whose crews were entirely lost, and 1,700 in the vessels of which the exact number of each was known, making a total of 2,289 lives, or 763 per annum; and that in the *last* three years the number of persons drowned was 810 in 81 vessels whose crews were entirely lost, 1,710 in the vessels of which the exact number of each was known, making a total of 2,524 lives, or 841 per annum.

Among the most prominent causes of such an immense waste of lives and property, which have been the subject of the committee's investigation, they mention:—"That drunkenness, either in the master, officers, or men, is a frequent cause of ships being wrecked, leading often to improper and contradictory orders and directions on the part of the officers; sleeping on the look-out or at the helm, among the men; occasioning ships to run foul of each other at night, and one or both foundering; to vessels being taken aback or overpowered by sudden squalls, and sinking, upsetting, or getting dismasted, for want of timely vigilance in preparing for the danger; and to the steering wrong courses, so as to run upon dangers which might otherwise have been avoided.

"That the practice of taking large quantities of ardent spirits as part of the stores of ships, whether in the navy or in the merchant service, and the habitual use of such spirits, even when diluted with water, and what is ordinarily considered the moderate quantity served to each man at sea, is itself a very frequent cause of the loss of ships and crews; ships frequently taking fire from the drawing off of spirits, which are always kept under hold; crews frequently getting access to the spirit casks, and becoming intoxicated; and almost all the cases of insubordination, insolence, disobedience of orders, and refusal to do duty, as well as the confinements and punishments enforced as correctives, both of which must for the time greatly lessen the efficacy of the crews, being clearly traceable to the intoxicating influence of the spirits used by the officers and men.

"*Experiments in American Vessels.*—That the happiest effects have resulted from the experiments tried in the American navy and merchant service to do without spirituous liquors as an habitual article of daily use; there being at present more than 1,000 sail of American vessels traversing all the seas of the world, in every climate, without the use of spirits by their officers or crews, and being, in consequence of this change, in so much greater a state of efficiency and safety than other vessels not adopting this regulation, that the public insurance companies in America make a return of five per cent. of the premium of insurance on vessels completing their voyages without the use of spirits, while the examples of British ships sailing from Liverpool on the same plan have been productive of the greatest benefit to the ship owners, underwriters, merchants, officers, and crews."

And among the "remedies proposed or suggested," we find:—

"*Diminished use of Spirituous Liquors.*—The encouragement, in his

majesty's navy, of the system,—so happily followed both in the ships of war and merchant vessels of America, and in some instances in the merchant ships of England, with the best results in every case,—of discontinuing the daily supply of spirits to the seamen as an article of necessary use, and substituting the more nutritious and wholesome beverage of coffee, cocoa, chocolate, or tea; so as to restrict the quantity of spirits supplied as stores, to the amount required for special and urgent occasions, to be served under the direction of the commander and medical officer of each ship, and at such periods only as they might deem necessary.

The Report is signed by J. S. Buckingham, Chairman. Lond. Naut. Mag.

Machine for the upward transmission of weights. A very ingenious machine for the upward transmission of weights of any description is now on exhibition at the Mining Hall, next Exeter-st., and deserves the attention of mine proprietors, wharfingers, and all persons who have the management of extensive stores, as one well calculated to save a great deal of time, labour and expense. The construction of this power is very simple, and its steady operation is quite assured. Its chief agent is a pair of wheels, or, if necessary, a series, moving with their diameters in the direction of the weight to be raised,—say the shaft of a mine. Taking the one pair of wheels, moving on the same fixed axis, we find that from the end of a radius or arm in each, a chain descends, so as to hang on opposite sides of a square passage. To each chain are suspended, at different but regulated distances, quadrangular frames, to the upper sides of which strong projecting iron rims, moving on the principle of the hinge, are attached. The boxes, or receptacles for the weight to be raised, have corresponding edges on each side. When the wheel above is turned, and a single box below is placed in connexion with the lowest frame, it is caught by its rim, and with one revolution of its wheel is sent up as high as the frame on the opposite side to that on which it is borne: here it is again caught and sent up to the apparatus on the opposite side again, and so on, by alternate transmission, it is brought on the top of the shaft. The machine being kept constantly laden below, and its wheel constantly turned above, it follows that at each revolution of the wheel a box is delivered, and thus, in an exceedingly short space of time, a vast body of matter can be carried up through any depth of shaft. It is not easy to describe such machines, however simple they may be, in very simple or intelligible language, and we have not been much practised at specifications. We must therefore leave scientific men to understand us through their own quick intelligence; and to all others whom the matter may concern, we recommend the employment of their own eyes. The machine could be most humanely employed in great mines in quickly sending the workmen up or down, to save them from their present tedious and tiresome expedients for that purpose. In unlading ships at wharfs its operation would be found amazingly rapid and proportionably convenient. It may be remarked also, that its operation is wholly unaccompanied by danger, and that its speed may be accelerated or diminished, or it may be stopped altogether at any moment, with perfect facility and convenience. On the whole, we must confess that we were struck with the complete efficiency of this admirable invention, which we are glad to find is protected by patent. Lond. Farmers' Mag.

Economical Butter. In Germany the working classes economize their butter, and at the same time render it more wholesome, by incorporating with it a certain quantity of potatoes. The latter are cooked by steam, skinned, reduced to a homogeneous paste by a pestle or rolling pin, diluted with the cream, and churned in the usual way. The butter is collected, washed, kneaded and salted in the common mode.

In Saxony, potatoes are mixed intimately with cheese curd, and of this mixture cheese is made which is deemed more nutritious and easy of digestion than common cheese. Jour. de Connais.

Time and Temperature Measured in One. M. Arago announced at the last sitting of the French Academy of Sciences, that a Danish watchmaker has invented a watch which at the end of the day indicates the mean temperature of twenty-four hours. Lond. Mech. Mag.

New Fact in Electricity. Professor Belli, of Milan, has published some experiments conducted by himself, which demonstrate that the negative electric fluid is dissipated in about half the time required by that which is positive. This fact had escaped the observation of Coulomb, and also of M. Biot. M. Peltier, greatly surprised at the difference thus found by the Italian Professor, is now engaged in an attempt to discover the cause. Mag. Pop. Sci.

Maize Sugar. Dr. Ballas having sent two specimens of the maise sugar to the French Academy of Sciences, M. Biot has submitted them to certain effects of polarization, in order to ascertain their precise nature. The deviation of the polarized rays to the right of the place of polarization in an aqueous solution of this sugar after filtration, and the proportion of its inversion to the left by the addition of liquid sulphuric acid, have been found by M. Biot to agree with the pure sugar derived from the cane. Athenæum.

Water Meter. At the United Mines, a water meter has been attached to Loam's engine, to ascertain the quantity of water injected into the boilers, and converted into steam, by the consumption of a bushel of coal (94 lbs.;) the result is as follows, iu July, 1836:—Loam's engine, 85 inches single; 2107 bushels of coal, from July 2 to August 5; 220,080 imperial gallons injected into the boilers; water evaporated by each bushel of coal, 104,4 imperial gallons, 16,7 cubical feet. Mining Journal.

Palladium. This metal has been extensively procured from the Gongo Solo mine, in the Brazils. Its use is valuable from its susceptibility of a high polish, and its resisting the atmosphere, weak acids, &c., for the graduated scale of mathematical instruments, for the tips of pencil cases in lieu of steel, for reflectors to light-houses, for surgical instruments, and for assay balances. Several are now being made for the United States mint in Philadelphia, of this metal. Ibid.

LUNAR OCCULTATIONS FOR FEBRUARY, 1837.

Calculated by S. C. Walker.

Day.	H'r.	Min.			N.	V.
16	12	3	Im.	c Geminorum, 6,	36	94
16	13	9	Em.		285	343
18	4	49	Im.	Mars' Centre,	1	310
18	5	0	Em.		339	286

Meteorological Observations for October, 1836.

Moon.	Days.	Therm. Sun rise.	Therm. 2 P. M.	Barometer. Sun rise.	Barometer. 2 P. M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inches.	Inches.			Inches.	
☽	1	43°	67°	30.04	30.04	S.	Moderate.		Clear—flying clouds.
	2	60	71	29.80	29.72	SW.	Brisk.		Clear—clear.
	3	44	58	29.80	29.85	NW.	Moderate.		Clear do.
	4	47	50	29.60	29.60	E.	do.		Cloudy—rain.
	5	43	50	29.30	29.30	N.E.	do.	.85	Cloudy do.
	6	30	52	29.65	29.70	W.	do.		Clear—lightly cloudy
	7	38	56	29.85	29.96	W.	do.		Lightly cloudy do.
	8	41	54	30.04	30.07	W.	do.		Do. clear.
	9	43	53	30.14	30.20	E.	do.		Clear—cloudy.
⊗	10	43	55	30.20	30.20	N.E.	do.		Cloudy—lightly cloudy,
	11	40	47	30.2	30.16	N.E.	Blustering.		Cloudy—rain.
	12	39	42	29.65	29.65	N.E.	do.		Rain—flying clouds.
	13	36	50	29.90	29.94	W.	Moderate.	1.90	Clear—frost—clear.
	14	42	64	29.80	29.70	SW.	do.	.92	Fog—lightly cloudy.
	15	47	59	29.70	29.72	W.	do.		Clear do
	16	46	57	29.94	29.94	E.W.	Blustering		Rain—clear.
	17	37	57	29.85	29.85	W.	do.	.25	Clear—frost—clear
	18	35	51	30.20	30.20	W.	Moderate.		Do. do. do.
	19	49	62	30.05	29.85	SE.	Brisk.		Lightly cloudy—rain.
	20	62	52	29.90	29.90	SW.	Blustering		Cloudy—flying clouds.
	21	36	43	29.90	29.80	S.	Moderate.	.22	Cloudy—flying clouds.
	22	30	50	30.10	30.10	W.	do.		Clear—clear
	23	32	60	30.10	30.10	W.	do.		Clear do.
	24	44	66	29.95	29.95	W.	do.		Clear do.
	25	44	44	30.05	30.15	W.	do.		Clear—cloudy.
	26	26	41	30.10	29.94	W.	do.		Cloudy do.
	27	32	42	29.65	29.65	S.W.E.	do.		Clear do.
	28	28	43	29.80	29.80	W.	do.		Hazy—cloudy.
	29	41	53	29.70	29.70	W.	do.		Lightly cloudy—cloudy.
	30	31	43	30.06	30.10	NW.	Brisk.		Clear
	31	27	41	30.15	30.30	NE.	Calm.		do.
Mean		39.94	52.87	29.88	29.89			3.14	

Thermometer.			Barometer.	
Maximum height during the month		71. on 2nd.	30.23 on	11th
Minimum	do.	26. on 26th.	29.30 on	5th.
Mean	do.	46.40.	29.88.	